ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXVIII. No. 53.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK 601

TECHNICAL ARTICLES:
Snow on Railways (*illustrated*) 602
Micro-Organisms in Water Supply 603
Evaporation Experiments at the Mt. Hope Reservoir, Rochester Water-Works 604
Pneumatic Caisson, Jacksonville, Fla., Bridge (*illustrated*) 604
Railway Station at Middletown, N. Y. (*illustrated*) 604
The Sanitary Protection of Hemlock Lake, Rochester Water-Works 604
World's Columbian Exposition; Transportation Building (*with inset*) 605
Civil Engineer vs. Mule 606
Sewage Disposal in America (*illustrated*) 611
Specifications for Proposed Pumping Engines for the City of Osaka, Japan 611
A New Westinghouse Air Pump and Engineer's Brake Valve (*illustrated*) 612
The Niagara Falls Power Tunnel (*illustrated*) 614
Standard Rail and Tie Plate of the Indian State Railways (*illustrated*) 614

PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS 607

EDITORIAL NOTES 608, 609
Railway Construction in 1892—Clearing Snow from Railway Lines—Brooklyn's Deficient Water Supply—Another Question of Engineering Ethics—The Decimal System in England.

EDITORIALS:
The Panama Canal Disclosures 609
American Competition in Shipbuilding 609

LETTERS TO THE EDITOR 610
Locating Transition Curves—The Cause of Typhoid Fever in St. Louis.

CONSTRUCTION NEWS 614-616
Railways, Electric Railways, Elevated and Cable Railways, Horse and Motor Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Irrigation, Sewers, Streets, Electrical, Contract Prices, Miscellaneous, Manufacturing and Technical, Current Price List.

A 1,000,000-gallon covered reservoir is to be built at Rockford, Ill., to store water from artesian wells. Bids for constructing the reservoir proper will be received until Jan. 9. The walls and bottom of the structure will be of concrete and the center piers of brick. The character of the roof is not stated. Mr. Chas. C. Stowell is City Engineer.

A Lake Erie-Hudson River ship canal convention is to be called on an invitation from the Chamber of Commerce, of Duluth, Minn. The reason given for the consideration of this subject is that inside of five years Canada will have a 14-ft. channel from the sea to the head of the Great Lakes. And in case of war England has over 100 gunboats in service that could thus enter the lakes. The time set for the convention is sometime in January next, and Washington, D. C., is to be the place of meeting.

Dr. Nansen's Arctic exploring ship "Fram" was launched at Laurain, Norway, on Oct. 26, and is thus described in "Engineering": Length on keel, 101.7 ft.; on water line, 13.2; on deck, 128 ft.; greatest width, 36 ft.; draft, light, 12.3 ft.; displacement, 530 tons. The keel is in two pieces, 14 × 14 ins., and the covering is 11 ins. thick. The keel is American oak, and the other timbers Italian oak, with the intervals between the timbers filled with a mixture of pitch, tar and sawdust. The inside lining is pitch pine from 4 to 8 ins. thick. The outer sheathing is in three layers, of 3-in. oak plank, then 4-in. oak and finally an "ice-cover," of 3 to 6 ins. of greenheart. The ship's sides will thus vary in thickness from 27 to 30½ ins., and the oak bow is 4 ft. thick. Various beams and cross-stays strengthen the vessel inside. The "Fram" is pointed fore and aft, and is there further protected by iron plating. The engine is of 160 I. HP., capable of imparting a speed of 6 knots, and the coal supply is good for 3 to 4 months' continuous steaming. She is rigged as a three-masted schooner. The whole aim of Dr. Nansen has been to construct a strong ship that will lift if pinched between ice floes—and he seems to have succeeded in this aim as near as man can. He will start on his "drift across the North Pole" in June, 1893, sailing direct for Nova Zembla; then to the mouth of the Lena River, and northward from that point until the ice-pack renders navigation impossible.

Another East River tunnel for railway purposes is the subject of a petition now before the New York Aldermen. The New York & Brooklyn Railway Co. asks for the right to build a tunnel under this river, commencing at Spruce St. and Park Row, in New York, and ending at Myrtle Ave. and Fulton St. in Brooklyn. The president of this company is Mr. B. S. Henning, who proposed a gravity-railway under the East River some years ago. A 4%-grade is shown on the profile presented for both approaches to the river tunnel proper. The railway will be operated by a cable running at a speed of 15 miles per hour, and the trains will consist of six cars, with seating accommodation for 96 passengers in each car. The trains will be run on 2½ mins. headway. The tunnel will be lighted by lectricity and ventilated by shafts. Mr. Oliver H. P. Cornell is Chief Engineer of the work, and Mr. George S. Morison and Gen. William Sooy Smith are the Consulting Engineers.

The most serious railway accident of the week was a derailment on the Atchison, Topeka & Santa Fe R. R., at Husted, Colo., 15 miles from Denver, on Dec. 22. A passenger train was running at high speed when some of the cars left the track. The express car turned over on its side and rolled down the bank. The smoking car followed and immediately took fire. The flames spread to the next car, which was the day car. The front end of this car was on the top of the bank and the other end was at the bottom. This car and the smoking car were destroyed. The Pullman turned on its side on the bank. The tender left the rails, but the engine remained upon them. About 20 persons were injured, at least two of them fatally.

A locomotive boiler explosion occurred on Dec. 18 in the roundhouse of the Grand Trunk Ry., at London, Ont. The engine was about 20 years old, and had been turned out of the repair shop but a few weeks before. Two men were injured. It is supposed that the safety valve had got out of order.

The Love electric conduit system for street railways (Eng. News, March 19), is being laid for about two miles in Washington, D. C., by the Rocky Creek Ry. Co. The yokes weigh 260 lbs. each, the slot rail 50 lbs. per yd., and the Johnson grooved girder track rails, 62 lbs. per yd. Cast iron shields are used for the sides of the conduit and concrete for the bottom. The depth of the conduit will be 18 ins., and sewer connections will be made every 100 ft. for drainage purposes. The conductors are copper, ¼ in. diameter, furnished by the John A. Roebling's Sons Co. The contractors for the work are Christie & Lowe, of Chicago. From 18th and W Sts., outside the center of the city, to Chevy Chase, the terminus of the road, the trolley system will be used, and through cars will be run. The work includes a cable crossing, 200 ft. of curves, three turnouts, and a number of crossovers and surface track crossings.

An electric railway system without overhead wires or underground conduits has been brought out by Mr. Wynne, late manager of the Brush Electric Light Co., of London. The main principle of the system is the use of charged sectional contact rails covered by the moving car. These are laid in the roadway parallel to the ordinary track, and successively charged from an underground insulated conductor, but only those contact rails are electrically charged which are actually under or so close to the moving car as to absolutely protect the ordinary traffic of the streets from the possibility of contact with the electricity. The chief engineer of the Electric Construction Co. is said to guarantee the efficient working of a line laid on Mr. Wynne's system.

Dining and kitchen cars are to be run on the East Coast route between London and Edinburgh, and proposals have been invited for eight dining cars for this service, to be built according to specifications and plans prepared by Mr. Wilson Worsdell, Locomotive Superintendent of the Northeastern Railway. Four of these will be for first class passengers and four for third class passengers, two being for service and two for reserve. It is intended to run them on the 2:30 p. m. northbound train from London and the 2:30 p. m. southbound train from Edinburgh. A separate kitchen car will be run between the first class and third class dining cars, and it is hoped that all the cars to be run on the train along with the dining cars will be corridor cars, so as to give communication from one end of the train to the other. It is expected that the trains may be ready for use next summer. The corridor cars on this route were described in our issue of Feb. 7, 1891, and the Great Western Ry. corridor cars in our issue of April 28, 1892. The plan of having a separate kitchen car is in use on some French railways.

The second-class has been abandoned by the Great Eastern Railway, of England, following the example of nine other companies, which now have only first and third class passengers. The Great Eastern Railway still retains the second class for its suburban service, on account of the large number of season tickets issued for this class, but, as we have several times pointed out, it is the third class of car which should be abandoned, and the present second class accommodation provided at third class rates, thus leveling up instead of down. The Great Eastern Railway has a number of third class cars, open from end to end, while the modern third class cars of the Midland Railway (which has no second class) are quite equal to the ordinary second class cars of other roads. Eventually we may expect to see first and second class only (instead of the present anomaly of first and third class only), with an extra fare for parlor cars, as in the United States.

Portland cement for steam and water joints was lately refered to in this journal as a late German application. A correspondent of "Engineering" says he has used Portland cement for this purpose for some years. But he adds "a little common soda" to the cement, and says that 30 minutes after application the pressure of either steam or water may be safely admitted to the pipe thus jointed.

The dry dock now being built by the Port Townsend Dry Dock Co., at Point Wilson, at the entrance of the straits of Juan de Fuca, will be 480 ft. long, 120 ft. wide at top and 85 ft. wide on the bottom, and 38 ft. deep. The floating gate will be 60 ft. long. The main portion of the dock will be built of 10 × 14-in. cedar timber, backed by broad piling.

The sanitary condition of Chicago has been better this year than it was last, so far as is shown by mortality records. According to figures compiled by Health Commissioner Ware, of Chicago, there were 27,754 death in 1891, and but 26,073, of 1,681 less, in 1892, the deaths for the last half of the present month being estimated at the rate for the first half of the same month. The total number of deaths from cramp, diarrheoral diseases, diphtheri, scarlet fever, measles, typhoid fever and smallpox, all zymotic diseases, in 1892, was 5,348, against 6,114 in 1891. Typhoid fever, which caused such a large number of deaths in 1891 1,997, 7.19% of all deaths for the year, caused 1,488 or 5.67% of all deaths in 1892. This is an extremely low mortality, the average per cent. of typhoid to total mortality for the 22 years, 1870 to 1891, as shown in our issue of April 21, 1892, having been 3.23% in Chicago; 1.17% in New York, and 2.93% in Philadelphia. Chicago's total death rate is comparatively low. The new four-mile water intake tunnel has just been put in use, and it is hoped that the typhoid death rate will drop much lower in 1893.

A division of the city water-works of Minneapolis, Minn., into low and high service systems is recommended by Mr. Andrew Rinker, City Engineer. Mr. Rinker is reported as stating that the average pressure maintained at the pumping station is 75 lbs., while a pressure of 50 lbs. would serve a very large portion of the city.

Some advance figures from the forthcoming report of the Interstate Commerce Commissioners' Statistician have been distributed to the press. We shall, however, postpone publication of most of these figures until the advance proofs of the report itself is received, and an abstract and analysis of permanent value for reference can be made. At present we give only the following figures, which apply to the railway system of the United State as it stood on June 30, 1891:

Total mileage of railway lines*	168,403
Total trackage, including additional tracks and sidings	216,149
No. of independent operating railway companies	889
No. of companies controling 1,000 miles or more	42
No. of companies having receipts over $3,000,000	80
No. of roads abandoned during year	16
No. of roads consolidated with others	92
No. of locomotives, all classes	32,139
Increase over previous year	1,909
No. of cars, all classes (except cars owned by private Cos.)	1,215,611
Increase over previous year	45,944
Increase in cars and locomotives with automatic couplers	53,716
Increase in cars and locomotives with air brakes	39,506
No. of men employed on railways	784,285
Increase over previous year	34,984
Total capitalization of railways	$9,829,475,015
Average capitalization per mile of line	60,942
Increase over previous year	602
Gross earnings ($6,801 per mile)	1,096,761,395
Operating expenses ($4,538 per mile)	731,887,893
Net earnings ($2,263 per mile)	364,873,502
(Decrease in net earnings per mile from previous year	$37)
Passengers carried	531,183,988
Passenger-miles	12,844,243,881
Tons of freight	675,608,323
Freight ton-miles	81,073,784,121
Passenger train-miles	307,927,928
Freight train-miles	446,274,508
Killed by accidents (Emp., 2,660; Pass., 293)	7,029
Injured by accidents (Emp., 26,140; Pass., 2,972)	33,881

The report urges legislation to hasten the brake and coupler reforms, and makes special reference to the need of other devices to secure greater safety. The block system is brought forward with especial prominence, and the Statistician is now making inquiries as to the extent of its use.

* The mileage at the present date, according to the statistics which we give in this issue, is about 174,700 miles, which is 45% of the total mileage of the world.

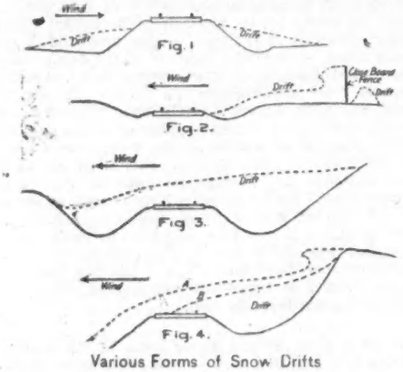
SNOW ON RAILWAYS.*

By J. W. Harkom.

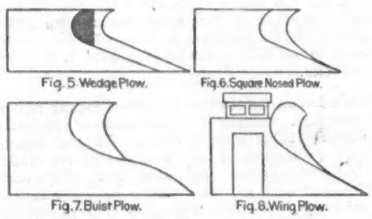
(The author began with a reference to the fact that the railways which experience most serious trouble with snow are those located in latitudes where heavy snow falls are infrequent, owing to the fact that they make less preparation for dealing with snow than roads located farther north.

He then described and classified the various ways in which snow falls and settles. Heavy falls of light, soft snow are easily cleared away. What gives serious trouble is the drifts and the occasional formation of ice under the snow when soft, wet snow falls on deeply frozen ground, or the formation of a hard crust when a storm of soft, damp snow is followed by a cold snap. The filling of flangeways by drifting snow, which often occurs when no storm is in progress, is also a cause of great annoyance.

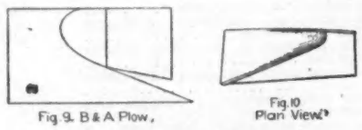
When drifts of damp snow freeze, or when sand and earth is mixed with driving snow in a drift, it is very dangerous to run snow plows against it. A side drift of this type across the track is almost sure to cause derailment, and even a drift of uniform depth may lift the leading wheels from the rails. In the case of a damp snowfall with ice forming underneath, handwork with a pickaxe is often necessary to the safe passage of trains.—Ed.)



Various Forms of Snow Drifts



Single Track Push Plows. Various Types.



Two Styles of Double-Track Plows.

The snow fence stands first in merit among the successful methods of dealing with snow. The best fence for this purpose is a hedge-row of small evergreen trees. The common balsam or cedar is recommended, and when planted in three or four rows—the trees in one row covering the intervals in the other—the result is a snow fence that will never fail. As the trees require some years' growth to act efficiently, they should at first be supplemented by an outside close board fence. The Lombardy poplar has been used on account of its quick growth, but its branches are not close enough to the ground to make a perfect snow fence.

The location of any snow fence is necessarily governed by the direction of prevailing winds and the general features of the ground, but to be effective it should never be within 50 ft. of the center of the track, thus giving room clear of the roadbed for the formation of the drift. Excellent results have been attained by the setting up of temporary fences at greater distances than this, and in very bad places a good plan is to set up a double line, 100 ft. apart.

Snow walls have been cheaply built and with good effect, but in strong winds they are liable to be leveled and their tops blown away. To prevent this the author suggests the topping of a snow wall with a board nailed to a couple of stakes. When the drift reaches the top of the board it should be raised to a higher level. As a rule "second line fences" are not needed to meet the first storm, so that plenty of material is available to construct at small expense in this way a second line of defense to meet future storms. Should the snow on the ground melt away, the wall will still remain for some time, ready to meet the next storm, and in the spring it is a light matter to break it up, thus preventing any retardation of vegetation.

Portable wooden fences, in the shape of strong hurdles, are excellent auxiliaries of this class, both for "first" and "second line" fences. Snow fences built of wood are liable to destruction from fire in dry grass or bush clearing, but they can be protected by raising the boards about a foot from the ground, and stringing a wire to make good this space against sheep, etc. The bottom opening does not lessen the efficiency of the fence as the first snowfall generally fills the gap, or snow can be thrown there by the trackmen before the season of heavy drift sets in.

Snow sheds are of two distinct classes, one to cover a deep cutting (generally rock); the other, along the side of a hill or mountain, to guard against slides or avalanches. The former is a simple matter, no very great strains having to be allowed for, a strong roof truss is usually sufficient. In the latter class they call for careful design and construction, so that when tested they may carry weight and offer no obstacle to the sliding clear of snow, ice and stones. It should not, however, be forgotten that the hauling of trains within snow sheds is a matter of trouble and difficulty, as the rail in them is often "bad," either "greasy" in summer or "frosty" in winter, and keeping the track to surface increases the trackman's duties. There is also the fire risk. There are portions of railway in the Rocky Mountains where in summer the road is carried round outside the sheds, showing the preference for open track.

The author emphatically endorses the principle of keeping the snow off the road as the best way to work a railway. A certain amount of snow on the banks is a benefit, materially reducing the ill effects of frost on the roadbed.

In discussing plows those used on the single track will be first considered. The accepted type is the wedge or V nose shown in Fig. 5. This plow does its work well in an even fall of snow up to 2 ft. deep, but the majority of them do not clear snow of greater depth because they cannot dispose of more than that quantity through the curved discharge at top, which is nearly always too small. The deeply drifted snow either piles on top of the plow or breaking it off falls close to the channel cut out and so back upon the track. Another fault in construction is that the V nose leads the snow to the side of the plow too soon, delivering it too close to the track. The idea of the original designers appears to have been to turn a furrow, as a farmer in his field; but snow should be first lifted and then delivered at one side as far from the track as possible. To secure this the roadmasters call for fast running.

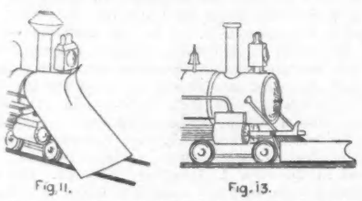
To assist such a plow to deliver snow far from the track the curved delivery should be of greater capacity, and a practical rule for design would be to make it at least one half the total depth of plow, for it must be remembered that to do the work intended it has to pass to each side one half of the snow the plow runs through. A brief consideration will show that for a plow 10 ft. wide working in snow 3 ft. deep, the area of this portion (shaded in Fig. 5) should be 15 sq. ft., or the snow will go over top or fall at sides of plow and close to track.

A better design of plow has been coming into use of late years in which the nose is square instead of V shaped, and the best snow clearing under the author's observation has been done by them (see Fig. 6). This design is much safer, as it will lift a side drift, and when one side is full will pass the snow to the opposite side. The author has had personal experience with a plow of this pattern for ten years, and it never failed in any kind of drift, or got off the track.

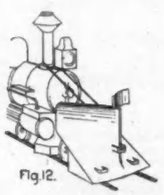
Variations have been made in the shape of the center of plow front, notably in the Buist plow (Fig. 7) which combines in its shape two of the points necessary for effective working pointed out in the foregoing, viz., a full clearance for delivery and the square nose. The author considers the hollowing of the front or raising the sides (shown by dotted lines) to be objectionable, as it confines the snow too much.

A pattern of plow much in favor on some roads is a large wing plow, which can be used for breaking a road first and afterwards for widening the snow banks and scraping the rail. They generally have in front a movable apron for scraping flanges. This plow is very high, has a square nose, and an unusually high delivery (see Fig. 8). Excellent work has been done with them, but they must be run at high speed, which, in front of an engine, is open to serious objection.

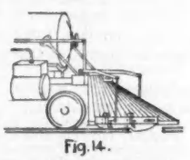
We now come to machine plows. Of these the only one worth considering is the "rotary," and with it wonderful work has been done; but it should never be lost sight of that although unrivaled for emptying a full cutting, the cutting should not be allowed to get full. Descriptions of the "rotary" are so numerous that space need not be taken to describe it here. Its progress is slow, but it does its work effectively. It is expensive to operate, but less so and leaves its work in a better shape than "a shovel brigade."



Common Styles of Plows for Engine Pilots.



Improved Pilot Plow, Drummond Counties Ry.



The Temple Flange Scraper for Engine Pilots.

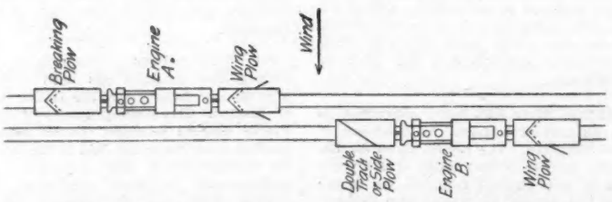


FIG. 15.—PROPOSED ARRANGEMENT OF PLANS FOR CLEARING DOUBLE TRACK.

The wing plow* is the most effective ally a roadmaster has, in moving snow back from the track after the ordinary breaking plow has passed through. It is constructed much as an ordinary square nose plow in front, except that generally its nose has an iron apron movable at will, to clear switches and crossings. When the apron point is lowered it cuts hard snow a little below the rail level. The "wings" proper are huge doors hung on sides and operated from within, and when fully extended press back the snow on each side to a width of 15 ft. The wings are usually operated manually, by rack and pinion, under signal received from a "lookout" man.

The author has for two winters had a wing plow operated by compressed air, each wing being connected by a rod and piston to a 10-in. cylinder, having a motion of 3 ft., sufficient to fully extend the wings and allow them to return home to the sides of the plow. The return pull is secured by two cylinders of the same size, working with a shorter stroke, coupled close to the hinge of the wing. Air pressure is admitted to each wing by a three-way cock, handled by the lookout man. One great advantage claimed for compressed air is that should a drift be too heavy, the wings instead of being held out until the pinion, its dog or the rack breaks, or the engine is stuck, will close in until the pressures equalize. Then if necessary the

* Condensed from a paper before the Canadian Society of Civil Engineers.

* See full working drawings of wing plows used on Intercolonial Ry. since 1885 in Eng. News, July 12, 1890.

plow is backed up and another run taken to finish the job. The working pressure on the wings can be so regulated that resistance need not exceed the tractive force of the engine.

It has been assumed in the foregoing that the wing plow is hauled behind the locomotive, as no plow with men in it should be run in front of an engine. Using an apron in front of a wing plow in opening a road is very dangerous; the apron is liable to be raised by drifts and derailment follows. It is after the road has been opened for engine passage that the apron will do good work.

Of double track plows there is little to be said, their system of working being in practice far from perfect. The Boston & Albany R. R. ran (the author believes) some years ago a plow with a movable nose hung vertically, (Fig. 9), by means of which snow could be thrown on either side, at will. But that did not clean out the space between the tracks, and the trouble of throwing snow from one track to the other still remained, as well as the objectionable ridge in the center. The common shape of the double track plow is that shown in Fig. 10, and is built with a square nose. This practically shovels up all the snow in front, passing it to the outside of track. The matter of clearance is of great importance in this plow, but has apparently not received the attention deserved, as the clearance instead of being double that required in a single track plow, is so far as the author has noticed, no greater than that given to single plows.

Of fixed or engine nose plows there are a variety, and some have been patented. They are generally of sheet iron with square nose, and of shape shown in Fig. 11, practically a large shovel. An objection to this class is that they are troublesome when the engine backs up, gathering snow underneath, and eventually either stalling the engine or breaking the plow.

The author has given much attention to engine plows. Fig. 12, illustrates one built and successfully running (worked both forward and backward), on the Drummond Counties Ry., Province of Quebec, during two winters.

It is found that the guards on the sides of the engine truck keep the snow out of the plow when backing up, and a heavy triangular scraper hung underneath at the front end, made an excellent road. In March, 1891, one of these plows assisted by an engine broke through, near Barrie, Ont., at one run, a drift a quarter of a mile long and from 4 ft. to 6 ft. deep, although only designed to work its way through 2 or 3 ft. of snow. The square front of the plow has been found to give the greatest safety, no case of derailment in any kind of drift having been experienced. For several winters on the Arthabaska and Doucet's Landing Branch, Grand Trunk Ry., one of these plows did good work in keeping the track open, the train always getting through. During the same storms the greatest difficulty was experienced on the Quebec main line.

Another kind of nose plow much used years ago is shown in Fig. 13. It is not a good thing to use when the snow is deeper than its top, because it acts as a harpoon, offering great resistance to backing out of a drift, requiring much shovel work to clear it so as to admit of backing without the whole affair being torn off. It also gathers snow underneath in backing up.

We next come to scrapers, considering first those used on engines. There have been two kinds used on the Grand Trunk Railway, as noticed by the author. The first was the "Goulette," the design of an intelligent conductor, who, no doubt, had many times, in the early days taken his turn at holding the shovel on the rail in front of an engine to help it up a grade in stormy weather. His design, which was to hold the shovel mechanically, has been superseded by the "Temple" scraper (Fig. 14), fitted to the pilots of engines. This consists of an iron body hinged loosely at the front ends, and lifted or lowered to the rail by an arm or crank shaft worked by the engineman from the cab. To this body is attached a steel blade hung by hinges at the top, and held in a vertical position when working by two steel springs, thus allowing the blade in case of being accidently run onto a switch or other obstruction to give way and slide over it. The author has seen these scrapers do work that had previously been considered work for an independent plow.

Care should be taken in fitting the scrapers that they are always of the same figure on the bottom of the blades, and that when on the rail the whole stands level. Failing this precaution they will not work alike, the work being unevenly distributed by reason of some having to scrape hard snow left by the others. They cannot do such work, and hence the scraper gets the discredit which is properly due to want of uniformity and care in fitting.

We next come to the scraper fixed to a car and worked at the rear of the train. The "Goulette" scraper is a crude arrangement of heavy molded blade set at an angle to the rail and shaped to cut a space 10 ins. wide and 1½ ins. below rail level inside the rails and down to rail level outside the rails. It is operated by a man moving a heavy lever attached to the framework carrying the scrapers, a set being fitted on each end of the car outside the wheels, so that running in either direction, the last thing on the train is the scraper, and no serious damage is likely to result from failure to lift it at switches, crossings, etc., as not infrequently happens on account of the uncomfortable position of the man working it. The Maine Central Ry. has improved on this arrangement,* putting the scraper in the center of the car and working it by men in the body of car, which is a better position for the "lookout."

A similar construction on the Portland division, Grand Trunk Ry., under the supervision of the author, has done its work well for years, with comfort to the men and without derailment. The arrangement for working is more convenient, certain and rapid in action, and the scraper is so made that on striking a switch or crossing plank, it only breaks off the part below the rail. This cannot throw a wheel off, and the injury can be repaired in a few minutes. The author has heard of scrapers of this class being used on the American Pacific railroads in the Rocky Mountains, which are operated by compressed air. Doubtless they did good work, air being quick and sure in its action.

As already stated, the author advocates preventive methods in dealing with snow.

The question of cuts and fills will always in uneven country have, in connection with first cost, a very important part in governing the profile of a road, at the same time in the case of roads liable to be visited by snow, the avoidance of snow troubles should be taken into consideration, and where possible, cuttings should be made wide and shallow to give room for drifting. On prairies the rails should be 3 ft. above ground level, then neither snow fences, nor snow plows will be required, engine scrapers with an occasional trip of the car scraper being sufficient to thoroughly clean out the flanges.

In summer the snow clearing apparatus should be overhauled and repaired; the snow fences attended to, and fresh fences ready for use where experience has shown them to be necessary. All should be ready for use by the second week in October. Fences are by far the cheapest method of dealing with snow. They require no wages and do better work than a gang of men shoveling. The latter, unless great expense is incurred in casting the snow a long distance back, only aggravate the difficulties of future storms. Intelligent and thorough observation of the prevailing winds will assist in locating fences, which, as before stated, should be put well back from the track, and not necessarily placed parallel with it. Such preparations being made, the approach of winter and its snowstorms can be met without anxiety. Knowing that all possible has been done to keep snow off, it only remains for the intelligence department to watch "Old Probs," and when his predictions are being verified, to see that freight trains are not started without a fair probability of their reaching their destination.

When it is known that a heavy storm is commencing, start no freights, and make arrangements to run plows ahead of passenger trains to keep the road open. This enables freight trains to be started out directly the storm abates, and on the first sign of abatement, preparations should be made to shovel out sidings and switches to prevent delay. As a rule, work of this kind done during a storm is wasted.

There are many days in winter when full summer loads can be hauled, but in bad weather it is not economy to load engines to the sticking point.

A careful and thorough system of telegraphic reports of weather from all parts of the line, in addition to the meteorological predictions, should be enforced; train loads and movements can then be safely arranged.

However, let us suppose that in spite of all precautions a heavy block has occurred, that some cutting has drifted full, the ordinary plow has failed to make its way through, and assistance is asked for. Intelligent action is then necessary to prevent damage to rolling stock. It has only too often been the practice to put extra engines on and try to ram the plow through, usually resulting in smashing it and the engines. A good rule is "that what one engine and plow cannot go through is not safe to run at."

In coupling plows to engines it is necessary to couple closely with small short links to allow the plow to break away from the engine in case it jumps the track. These small links are not to be used for pulling the plows, but only in pushing. Sometimes, if the snow is soft and damp, although deep, two or three engines moving at a walking pace can push a plow through it safely; but if the temperature is low, that cannot be done, the drifted snow being so hard that one might as well try to dig the cutting out of the original earth by the same means. Under these conditions the "rotary" if on hand will do good work. If the drift is not more than 6 or 7 ft. deep, the line can be opened quickly by taking a gang of men and setting to work in pairs about 15 ft. apart, to dig cuts across the track about 12 ft. wide and just long enough for themselves to work in, going down till they find the rail, and leaving it bare for 2 ft. in length. Two hours of this kind of work with a gang of 20 men will prepare for opening a long cutting. When all is ready the plow will at every opening get relief, and the engine a chance to work. The cut being opened, it should be widened in preparation for another storm. Unless this widening is done at once there is no certainty that the cut will not soon be worse than the previous storm left it. A roadmaster should never neglect the widening of snow cuttings and the leveling down of banks close to the rail. The wing plow is a good auxiliary for this work, but frequently where the rotary is not used snow must be carried away on flat cars.

The clearing out of the mouths of culverts to admit the free passage of melted snow is very necessary, and general freedom of drainage requires attention. Thaws and rains are often sudden, and as promptly followed by fall in temperature tending to freeze the road solid in a short time. When ice has formed on the track it can only be removed by the pickaxe. No plow or scraper can clean the rails, and any attempts to force engines over or through it before a thaw has thoroughly set in, must result in disaster. Resort must be had to hand labor to clean the rails and flanges, and it is a costly undertaking.

(Concerning the clearing of snow from railways having double, triple or quadruple tracks, the author proposes a plan for quickly and cheaply clearing the snow from the whole width of the roadbed as follows: Have at each division terminus a complete equipment in constant readiness for service, and start work from whichever end of the division is best to enable the prevailing wind to assist the side plow in carrying off the snow. Making sure that the section to be cleaned of snow is clear of trains, start an engine on the windward track, pushing an ordinary square-nosed plow before it and pulling a wing plow behind. The square-nosed plow throws the snow to each side and the wing plow following forces further back the bank on the windward side and cleans the snow from the space between the tracks, throwing it over to the lee side. Following this on the other track comes an engine pushing a side-plow (like Fig. 10) and pulling a wing plow with only the wing on the lee side spread. The accompanying diagram, Fig. 15, will make clear the method of operation. For each additional track an additional engine with side and wing plow will be required.—Ed.)

* See Eng. News, Sept. 19, 1891, for working drawings.

MICRO-ORGANISMS IN WATER SUPPLY.

Some interesting particulars of the quality of water for the supply of large cities were given by Prof. Percy F. Frankland recently in his evidence before the Royal Commission on the Water Supply of London, and we give below an extract from a letter by Dr. Frankland to the London "Daily News."

My statements dealt with the two aspects from which every question of water supply must now be regarded —the chemical and biological. In regard to the chemical character of the water supplied to London, I pointed out that exception could not be taken to it on the score of the quantity of organic matter present, inasmuch as it is generally less in amount than that contained in such highly esteemed water as that which is supplied to Glasgow from Loch Katrine. In regard to the quality of the organic matter in the river waters this must be judged from a biological point of view, inasmuch as it is only living or organized organic matter that has to be feared. Before the year 1885 pactically nothing was known as to what would be the fate of dangerous living matters (pathogenic micro-organisms), gaining access to the rivers above the intakes of the water companies, and their possible or even probable conveyance to the London water consumer, not unnaturally excited suspicion. In 1885, however, the more recent and exact methods of bacteriology were first applied by me to a systematic investigation of the London water supply, with the result that I soon discovered that in the processes of storage and filtration, to which the river water is subjected before delivery, a most remarkable proportion of the micro-organisms present in the raw river water is removed before delivery to the consumer. Thus, during the three years, 1886, 1887 and 1888, the whole of the London water supply was monthly examined by me for the Local Government Board, and resulted in showing that in the case of the Thames water, out of every 100 micro-organisms present in the unfiltered water, 97.6 were removed by the companies' treatment in 1885; 96.7 were removed in 1887, and 98.4 in 1888. The importance of these results lies in the fact that it shows the great difficulty which any micro-organism, whether harmless or pathogenic, present in the untreated river water must experience in passing through the companies' works, and so reaching the consumer. These

results, which have since been confirmed by a number of other people, have undoubtedly profoundly modified the aspects of the question of water supplies from river and other surface sources. I also showed some seven years ago that when water containing solid particles in suspension is permitted to subside, a very large proportion of the micro-organisms present are carried down with the solid matter to the bottom, and I have quite recently demonstrated that this phenomenon takes place in a most striking way in storage reservoirs. Any pathogenic micro-organisms, in which alone we are interested, finding their way into the rivers, will have to traverse these streams for greater or less distances, in which passage there is reason to believe that many will succumb, while many will be deposited in the bed of the river. Any, however, reaching the intakes of the water companies will be carried into the storage reservoirs, and during the period of repose which they will there experience they will share in the process of sedimentation, and be more or less carried to the bottom along with the other suspended particles present, while they will, at the same time remain in competition with the water bacteria, and have their number thus further reduced; but any still remaining in suspension after the storage reservoirs will pass on to the sand filters, which have been proved to act as such powerful obstacles to micro-organisms. Even assuming that any pathogenic forms should pass all these barriers their small absolute number, their isolated condition, and probably also their attenuated state and impaired vitality, must have deprived them of much, if not all, of their original capacity for mischief, and though, theoretically, such mischief may not still be absolutely impossible, it is for statistics and experience to prove that it does occur.

EVAPORATION EXPERIMENTS AT THE MT. HOPE RESERVOIR, ROCHESTER WATER-WORKS.

Experiments to determine the loss of water by evaporation were made in 1891 at the Mt. Hope reservoir of the water-works at Rochester, N. Y., under the direction of Mr. E. Kuichling, M. Am. Soc. C. E. The experiments were made to secure information to aid in planning works for a new supply.

The following description of the experiments, by Mr. Kuichling, with slight changes in the form of the table, is from the report of the Executive Board of Rochester, N. Y., for 1891-92:

The apparatus used consisted of two "indurated fiber" tubs, about 15 ins. in diameter and 5.75 ins. deep, in each of which an accurately measured volume of water dipped directly from the reservoir was placed, whereupon one of the tubs was exposed freely on the bank of the reservoir, while the other was floated in the reservoir at some distance from the shore, and held by cords in the middle of the surrounding framework, so as to prevent as much as practicable the agitation of the water in the floating tub by waves. The water in the tubs was 3.25 ins. deep, and its surface was 14.50 ins. in diameter, in every case; its volume just filled to the top a piece of 3-in. wrought iron pipe, which was placed vertically in a convenient position, and a cock at the bottom permitted the water to be discharged into the tubs. At the end of every 12 hours the water left in the tubs was carefully poured into the stand-pipe, and the distance from the top of the pipe to the water surface therein was accurately measured on a finely-graduated scale. The depth of water lost by evaporation in the tubs was thus magnified nearly 22-fold in the pipe. In case of rain the depth of the precipitation was accurately computed from the weight of the water caught in a 9-in. rain gage immediately after its cessation; and when the volume of water in either of the tubs exceeded that which was originally placed therein, the excess was also weighed upon delicate scales, whence the corresponding volume and depth in the tub was deduced by computation. By adding the measured depth of the rainfall to the original 3.25 ins. depth in tub, and subtracting from the sum the computed depth at the end of the period, the remainder will be the depth of the loss of water by evaporation during such period. The results so obtained, together with other data relating to the subject, are given in the accompanying table.

An examination of the figures on the foregoing table shows that the temperature of the water in the floating tub was very nearly the same as that in the reservoir, whereas in the case of the exposed tub, marked differences exist. It is, therefore, evident that the evaporation from the floating tub represents the actual evaporation from the reservoir much more nearly that the observed loss from the exposed tub, and, as no other method of measurement is available, it will be considered that the evaporation obtained from the floating tub is identical with that from the reservoir itself.

From the above figures and records of rainfall at the Mt. Hope reservoir for 11 years, Mr. Kuichling assumes that for the last 11 years the average evaporation for the four months, July to October, inclusive, was 16.79 ins.

Experiments in other cities show that the evaporation for the four months July to October, inclusive, average about 57% of the total for the year, on which basis 30 ins. has been assumed as the annual rate of evaporation in computing the necessary storage in connection with the new conduit and supply.

Rainfall, Temperature of Water and Air, Humidity and Evaporation from Water Surface at Mt. Hope Reservoir, from July 1 to Nov. 1, 1891, Preceded by Temperature and Humidity Records for the Same Period and for 21 Years Taken in Rochester.*

(U. S. SIGNAL SERVICE RECORDS.)

	Mean temperature of air in shade, F.°		Mean humidity of air, per cent.	
	1891.	1871 to 1891, inclusive.	1891.	1871 to 1891, inclusive.
July	67.1	70.2	67.0	68.4
August	68.8	68.1	74.6	69.8
September	66.0	61.8	75.2	72.2
October	50.4	49.2	74.7	74.4
Averages	63.0	62.3	72.9	71.2

(MT. HOPE RESERVOIR RECORDS.)

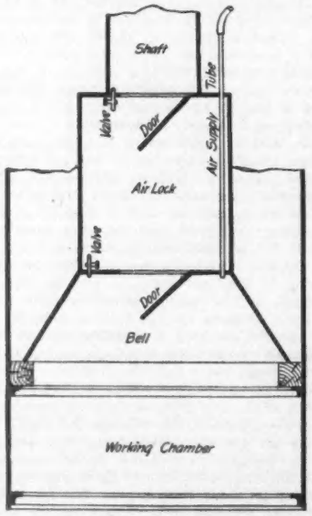
1891.	Rainfall, ins.	Mean temperature of air in shade, F.°	Temperature of water, F°, in: Reservoir.	Exposed tub.	Floating tub.	Evaporation ins. in: Exposed tub.	Floating tub.
July	3.44	70.5	68.2	70.4	68.8	6.46	5.39
August	2.95	70.3	70.2	71.7	70.7	5.70	4.93
September	1.44	68.7	66.1	68.4	66.5	5.04	4.05
October	2.16	53.3	54.4	51.7	52.9	3.55	3.23
Total and averages	9.99	65.7	64.7	65.5	64.7	20.75	17.80

* Taken at the top of Powers Block, in the center of the city of Rochester.

PNEUMATIC CAISSON, JACKSONVILLE, FLA., BRIDGE.

In a paper read before the Ohio Society of Surveyors and Civil Engineers, Mr. O. Benson, of Canton, O., described a bridge over the St. Johns River, at Jacksonville, Fla., built by the Jacksonville, St. Augustine & Halifax River Railway Co. Work was commenced in the winter of 1888-89 on plans prepared by Mr. George S. Morison, M. Am. Soc. C. E., and was completed early in 1890.

The structure is a single-track through bridge, made up of four 250 ft. fixed spans of mild steel and one draw-span of 218 ft. of the same metal. The approaches, 1,400 ft. long, were made of



Section of Pneumatic Caisson, St. Johns River Bridge.

creosoted pile work. The piers for the fixed spans were formed of two 10 ft. cylinders, one under each truss, connected by strong angle-iron bracing. The outer shell of these cylinders was made of soft steel ⅜ in. thick, and they were ultimately filled with a concrete composed of one part Portland cement, two parts sharp beach sand and three parts of the native "coquena," or sea-shell conglomerrate.

The pneumatic process was used in sinking the pier-cylinders. About 5 ft. above the cutting edge timbers, cut to the proper curve, were bolted to an angle-iron ledge, and upon these timbers rested the "bell" supporting the air-lock. This latter was of the usual type in doors and valve fittings. The shaft surmounting the air-lock was 3 ft. in diameter, bolted up in sections and provided with a ladder. The cylinders were weighted in sinking by bags of sand placed in the annular space surrounding the 3 ft. shaft, and water was also admitted to this part of the pier.

The material encountered in sinking was a soft coral rock of very irregular formation, which could only be removed by picks. The debris was hoisted up in bags through the air-lock. Progress was slow; 6 ins. per day being sometimes the maximum as logs were found imbedded in the coral, and veins of sand were struck often containing pure spring water. The depth to which the cylinders were sunk is not stated.

The draw-span was erected in place, but the fixed spans were built up on two barges, 1½ miles from the bridge site and towed into position. These barges were strong wooden boxes, each 114½ ft. long and 30½ ft. wide. The range of tide of 4 ft. was utilized in placing the spans on the bridge seats.

RAILWAY STATION AT MIDDLETOWN, N. Y.

The elevation and plan here given show the railway station now under construction at Middletown, N. Y., by the New York, Ontario & Western R. R. Co. from the plans of Mr. Bradford L. Gilbert, of New York.

The building is 174 ft. long and 44 ft. wide with a rear extension of 30 ft. in length for kitchen, an extensive awning, an independent express and trainmen's room at the north end and a porte-cochere. On the first floor are the general waiting room, woman's waiting-room, restaurant, ticket office, toilet-room and other rooms for baggage and trainmen. The general waiting-room is 30 × 30 ft. and both this and the woman's room are finished with a red oak wainscoting 12 ft. high; all above this and the ceiling is finished in white spruce. The floors in these two rooms are made of red oak, and all other floors of Georgia pine. The restaurant is 90 ft. long by 30 ft. wide, with news and cigar stands. There are open fires in this and in the waiting rooms in addition to the regular steam heating appliances.

The second floor is devoted to the railway offices, including rooms for the chief and assistant engineers, superintendent of motive power, train despatcher, roadmaster and various clerks and draftsmen. All these rooms are well lighted and heated and in both the second and third stories fire-proof vaults of brick and iron are provided for the storage of valuable records.

THE SANITARY PROTECTION OF HEMLOCK LAKE, ROCHESTER WATER-WORKS.

The pail system for the sanitary protection of the drainage area of Hemlock Lake, the principal source of the water supply of Rochester, N. Y. was used to serve 120 cottages and hotels during the year 1891, and in addition 54 barns and two sawmills were kept under close supervision. The work is done by and at the expense of the city of Rochester.

From June 1, to Oct. 1, 1891, the collection was made by a steam scow, which made 47 trips around the lake and collected 3,060 excreta pails, 171 large garbage receptacles and 3½ pails of dead fish. An engineer and three men at a total salary of $50 per week made up the crew of the boat. A total of 11.885 tons of bituminous coal was used by the boat which cost $4.72 per ton, delivered, or a total of $56. The wages of the crew for the summer were about $472, making the cost of the service for the four summer months about $922 for coal and wages alone.

During the balance of the year, about 35 weeks, a total of 1,694 pails were collected by means of a wagon and rowboat, the work being done by private contract for $6 per week, or a total of $240. The total cost of the service for the year, for labor and coal, was therefore about $1,162. In addition there was probably some expense for dis-

infectants used in cleaning the pails, and other incidentals, but these items are not given in the report from which the figures are taken.

In midwinter only 14 dwellings were occupied, their inhabitants numbering 68 people. It is estimated that during July and August there are on the average 1,300 people in the drainage area.

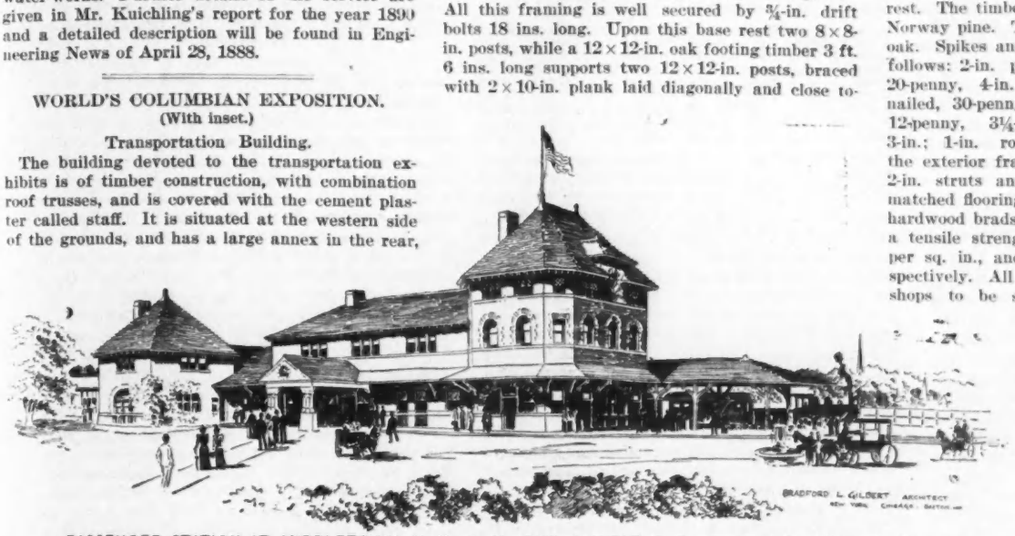
The organic matter collected is buried in trenches. From examinations of trenches in which decomposition has been going on for some time it is thought that with trenches not more than 3 ft. deep, "all traces of putrescible matter will have entirely disappeared at the end of three years, and that the same area may then again be utilized."

The sanitary service at the lake is in charge of Mr. D. H. Westbury and the above information is from the last report of Mr. E. Kuichling, M. Am. Soc. C. E., Chief Engineer of the Rochester water-works. Further details of the service are given in Mr. Kuichling's report for the year 1890 and a detailed description will be found in Engineering News of April 28, 1888.

WORLD'S COLUMBIAN EXPOSITION.
(With inset.)

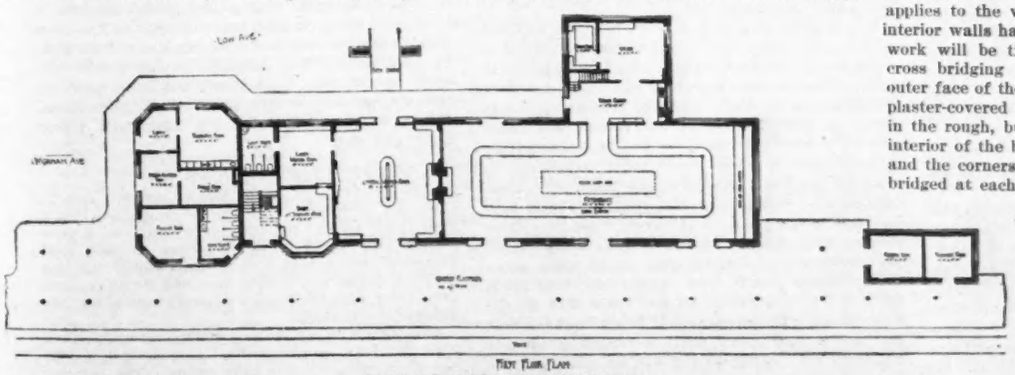
Transportation Building.

The building devoted to the transportation exhibits is of timber construction, with combination roof trusses, and is covered with the cement plaster called staff. It is situated at the western side of the grounds, and has a large annex in the rear,



PASSENGER STATION AT MIDDLETOWN, N. Y., N. Y., ONT. & WEST. R. R.; Bradford G. Gilbert, Architect.

while outside will be the special exhibits of the Pennsylvania R. R. and New York Central & Hudson River R. R. The building has been described and illustrated in our issues of Sept. 26, 1891, and Feb. 13, 1892. It is rectangular in plan, 960 ft. long by 250 ft. wide, covering an area of 5.5 acres. The annex covers 9 acres, and will be fitted with rows of railway tracks for the railway exhibits. The main building has three rows of triangular roof trusses, as shown on the plan. The middle row is above the others, forming a clearstory



PLAN OF MIDDLETOWN STATION.

roof. The architects were Adler & Sullivan, of Chicago, and the general treatment is very simple. A prominent feature, however, is the "Golden Gate," the main entrance, which consists of a single arch, deeply recessed and richly decorated in gold and color. The estimated cost was $280,000, and the contract price was $288,000, including the annex. We are indebted to Mr. E. R. Graham, Assistant Director of Works, for the following list of contractors: Ironwork and carpentry, Wm. Goldie & Sons, Chicago, Ill.; roofing and skylights, Smith & Cade Co., Chicago, Ill.; painting and glazing, W. H. Stubbings Co., Chicago, Ill.; lathing and plastering and exterior covering, Philipson Decorative Co., Chicago, Ill.; decorative work, Healy & Millet, Chicago, Ill.

The floor of the building is 7 ft. above datum, and calculated for a load of 150 lbs. per sq. ft. The foundations are of the "spread" type, distributing the pressure by wooden platforms under the columns, etc., as described in our issue of March 5. The general design of the foundations is shown on the inset sheet. There is a bottom platform 9 ft. 6 ins. square of 3-in. planks; across this are four 8×9-in. timbers, 9 ft. 6 ins. long, spiked to the planks; across these are three 10×12-in. timbers 7 ft. 6 ins. long, crossed again by three 12×14 in. and two 6×14-in. timbers 6 ft. 4 ins. long. Upon this timber framing are two 12×12 and two 9×12-in. timbers, 5 ft. 6 ins. long, laid close together. All this framing is well secured by ¾-in. drift bolts 18 ins. long. Upon this base rest two 8×8-in. posts, while a 12×12-in. oak footing timber 3 ft. 6 ins. long supports two 12×12-in. posts, braced with 2×10-in. plank laid diagonally and close together, in opposite directions and secured by 40d. nails. All the posts are secured at the bottom by dowels ¾×9 ins. and 4-in. spikes. The detail plan shows the method of supporting the outer end of the diagonal roof trusses G, 100 ft. span, by means of a cap resting upon two 12×12-in. posts. The system of bracing shown in this plan is placed at intervals of 10 ft. vertically.

As already stated, the roof is composed of three rows of triangular roof trusses of combination construction, and the construction of these trusses is very clearly shown by the drawings on our inset sheet. The middle trusses, A, are 96 ft. span; and the outer trusses, B, 75 ft. span. They are spaced 32 ft. apart, c to c, longitudinally, and are connected by the purlins, and by lateral and cross bracing, as shown by the plan. The trussed purlins are 6×12 ins., connected by ¾-in. tie rods, and carry 2×10-in. jack rafters, laid 3 ft. 8 ins. apart, c. to c. The main trusses A are 96 ft. span, 23 ft. 6 ins. high at the center, and are divided into eight 12-ft. panels. Below the bottom chord a diagonal member or strut runs to a footing against the post. The bottom chords are of three 6×10-in. timbers, placed 2 ins. apart, bolted together and having iron splice plates at the joints. The upper chords are of two 6×12-in. and two 4×12-in. timbers placed close together. The details of the castings used at the ends of the posts etc., are all shown on the inset sheet.

The building is rectangular, 250 ft.×960 ft. The middle portion is covered by a pitched roof with a continuous row of skylights in the ridge, and surmounted by an open lantern or tower with double balconies reached by eight elevators. Surrounding and attached to this part of the building is a two-story structure about 80 ft. wide, with a roof similar to the above. The second floor will be of ⅞-in. dressed and matched flooring. The roofs have combination wood and iron trusses, with combination trussed purlins on which the jack rafters rest. The timber will be sound common white or Norway pine. The keys in roof trusses will be of oak. Spikes and nails to be of steel and used as follows: 2-in. plank, blind nailed, for floors, 20-penny, 4-in. nails; 2-in. rough plank full nailed, 30-penny, 4½-in.; 1½-in. rough plank, 12-penny, 3¼-in.; 2-in. bridging, 10-penny, 3-in.; 1-in. rough bracing or sheathing on the exterior frame, 12-penny, 3¼-in.; toe nail all 2-in. struts and braces, 20-penny, 4-in.; ⅞-in. matched flooring and roof boards, 8-penny, 2½-in. hardwood brads. Wrought iron and steel to have a tensile strength of 50,000 lbs. and 60,000 lbs. per sq. in., and elongation of 15% and 24% respectively. All metal work before leaving the shops to be scraped free from rust and cinder, and given one coat of brown mineral paint mixed with pure boiled linseed oil. Turned pins and plain surfaces to receive a coat of white lead mixed with tallow.

The general constructions of the walls, pilasters, columns, etc., will be a system of posts supporting the weight of the galleries and roof, with smaller posts forming the corners and main uprights of the exterior walls, etc. The spaces between the posts will be filled in with 2×6-in. struts, cut to fit close and firmly toe-nailed. The framework of all exterior walls, piers, etc., will be sheathed with 1×10-in. sheathing laid diagonally and firmly nailed. Spaces to be covered by ornamental plastering are sheated solid. Between the main posts the inside face of the exterior walls is lined with studding 2 ins. thick spaced 16 ins. c to c, resting on the sill and extending up to the under side of the roof plates. This studding is bridged with 2×4-in. cross-bridging every 6 ft. in height. This applies to the walls of the clearstory, and to all interior walls having a plaster surface. The framework will be tied together by a set of diagonal cross bridging extending from the inner to the outer face of the walls. All posts in the walls and plaster-covered columns may be of white pine left in the rough, but all detached parts shown in the interior of the building are of yellow pine dressed, and the corners slightly rounded. The rafters are bridged at each bearing and in the center of each span with 2-in. plank bridging the full width of the rafters. The roofs will be covered, except at skylights, with 1×6-in. dressed and matched flooring boards, driven close, blind nailed to every bearing and furred up where necessary to form a shed to throw off the water. All furring for plaster work on walls, cornices columns, capitals, ceilings of lobbies or vestibules, etc., to be off sufficient strength and stiffness to affort good bearing for the outer covering of plaster, and to be firmly secured in place. The plaster covering extends over all surfaces except the roof. The center sash of each group of windows in the first and second stories, and every alternate sash in the clearstory is pivoted in the center. The exterior steps leading to terraces and loggias have strong plank stringers, ⅞-in. risers, and 1⅜-in. trends fitted with nosing

and scotia. The gallery and bridges across the building will be floored with ⅞×3⅜-in. faced, kiln dried, long leaf yellow pine, dressed and matched, fitted close to walls, driven close, blind nailed, and having all joints over bearings.

Railway Exhibits.

The classification of the exhibits of the Transportation Department was given in full in our issue of Sept. 20, 1891, and some particulars of the extensive historical exhibit to be made by the Baltimore & Ohio R. R. were given in our issue of July 28. Mr. Willard A. Smith is chief of the Department of Transportation Exhibits, and we learn from him that there will be about 47 locomotives exhibited by American contract builders, eight modern American locomotives built by railway companies and 15 European locomotives. In addition there will be a large number of reproductions of historical engines, the Baltimore & Ohio R. R. Co.'s exhibit including 20 or 30 of these. Outside the building will be two immense American locomotives erected on masonry pedestals, one of these being a Vauclain four-cylinder compound decapod engine (with five pairs of driving wheels and a ten-wheel leading truck) built by the Baldwin Locomotive Works, Philadelphia, Pa., being a duplicate of an engine built by them for the New York, Lake Erie & Western R. R. The following notes will give some idea of the exhibits:

The Baltimore & Ohio R. R. will have an exhaustive historical exhibit, including reproductions of English and American locomotives and cars, specimens of track, an interesting series of engravings, etc., as well as an exhibit of the historical and modern equipment of the road. There will be the track as laid on the first 14 miles (opened May 24, 1827), with strap rails on wooden stringers; the first locomotive, "York," built by Phineas Davis and purchased for $4,000; the first wagons and passenger cars, pulled by horses before engines were used, and the old "grasshopper" engines, some of which are still in service. The company has appropriated $55,000 for its exhibit. The Pennsylvania R. R. will have tracks laid with its 100-lb. rails 60 ft. long (Engineering News, July 21, 1892), upon which will be an express locomotive and a vestibuled train similar to the New York and Chicago Limited. There will also be the company's block signal equipment, and a passenger station with overhead bridge, etc., which will be outside the Transportation Building and at its south end. The exhibit is expected to cost $60,000. The New York Central & Hudson River R. R. will exhibit the first engine and train run in America, which ran on the old Mohawk & Hudson R. R., from Albany to Schenectady, N. Y., July 31, 1832. There will also be one of the first railway stations and other historical exhibits, in addition to the signal plant and the modern engines and cars of this road, including one of the great engines used to haul the Empire State express, the fastest regular long distance train in the world. The Old Colony R. R. will exhibit old and modern engines and cars. The Canadian Pacific Ry. will exhibit a transcontinental train, consisting of engine and tender, baggage car, colonist sleeping car, first-class car, and buffet sleeping car.

The Pullman Palace Car Co., Wagner Palace Car Co., and Krehbiel Palace Car Co. will have extensive exhibits. The Jackson & Sharp Co., Wilmington, Del., will build a mail car for exhibit, and also enter as an exhibit the open cars for the elevated electric railway in the grounds. The PneumaticGate Co. will have a working exhibit of its crossing gates. An historical exhibit of tickets, timetables, etc., has been specially prepared by Mr. George De Haven, general passenger agent of the Chicago & West Michigan Ry., and will be placed in a model railway ticket office about 40×15 ft. Illustrations, engravings, etc., of transportation systems in various countries will be shown by Harper Bros., Scribner & Sons, the Century Co., etc.

The foreign railway exhibits will include a large historical collection of old types of English track, sent by Mr. C. E. Stretton, of England, and a number of old engines or reproductions of them, and several English railway companies will make exhibits. The governments of France, Germany, Belgium and Austria will send engines, cars, models of stations, bridges, etc., of the state railways, and there will also be a large relief map of the Gothard Railway in Switzerland. There is no doubt that the railway exhibits in this department will be very comprehensive and interesting from an historical and technical point of view, and interesting to the general public as well as to engineers and railway men. The above notes refer only to the railway exhibits in the department, but, as will be seen by reference to the classification in our issue of Sept. 26, 1891, the scope of the department comprises every means of transportation, from perambulators, elevators and canoes, to locomotives, steam and sailing ships, air ships, cash railways, carriages, etc.

Fine Art Exhibits.

The Art Building (Eng. News, Feb. 13, 1892), is a fire-proof structure built at a cost of $500,000 to $600,000, to the designs of Mr. C. B. Atwood. The allotment of wall space to the various countries is as follows, the number of square feet representing the hanging space:

	Lin. ft.	Sq. ft.		Lin. ft.	Sq. ft.
United States	2,475	34,636	Norway.....	550	8,462
Great Britain	1,401	20,325	Sweden.....	497	7,005
Canada.....	193	2,895	Denmark....	272	3,930
France.....	2,082	33,393	Russia.....	554	7,725
Germany...	1,438	20,400	Spain.....	550	7,807
Austria.....	866	11,594	Holland.....	658	9,337
Belgium.....	835	12,318	Japan.....	206	2,919
Italy.....	810	12,410	Mexico.....	125	1,500

As in many of the other departments the space applied for had to be cut down in many cases, the aggregate amount asked for exceeding the total available space. The space allotted to Great Britain, Germany, etc., includes, as a rule, that for their colonies. The picture line is 30 ins. above the floor. The four great galleries in the nave and transept will be devoted to the collections of sculpture and monumental decoration, as well as to architectural exhibits. The two annexes were provided for in the original design and are in harmony with the main structure. It is not expected that this collection will equal that at the Paris Exposition of 1889, because many foreign artists are not willing to risk the transportation of their pictures across the ocean, and there are also many pictures owned abroad by governments or galleries which cannot be removed from the country.

Manufactures and Liberal Arts.

The great building described and illustrated in our issues of July 28 and Sept. 1 and 8, 1892, was intended to accommodate the Department of Manufactures and the Department of Liberal Arts, but a separate building has been provided for some groups of the latter department, including that of education. Notwithstanding the vast amount of space in this building, it has been found necessary to cut down the applications of exhibitors to such a degree that many protests have been made. The most important group of the Liberal Arts which will be housed here are music, hygiene, medicine and surgery, books and literature, physical research, engineering and architecture, and religious and social associations.

The growth of public interest in these subjects may be seen from the statistics of space alloted to them in previous exhibitions. At Philadelphia, in 1876, these groups, including education, occupied 35,782 sq. ft.; at Paris, in 1878, 111,000 sq. ft.; at Paris, in 1889, 304,300 sq. ft. But of this latter amount a large part was given up to safes and the miscellaneous exhibits from other countries, so that the last Paris exhibition gave only about 244,000 sq. ft. Archaeology and ethnology were also included in this area. At Chicago these two latter groups, with the educational exhibit, are provided for elsewhere, so that the amount of space given to the liberal arts is more than double that given to it at Paris in 1889, and ten times that at the Centennial in Philadelphia. It is not intended that any heavy machinery shall be operated in this building, but electric power will be furnished for light machinery.

Naval Exhibit.

The naval exhibit (Eng. News, Feb. 13, 1892), will be of special interest to visitors from the western portion of the country, who have never had an opportunity of seeing the vessels of the new navy. It includes a full-sized model of a cruiser, on piling in the lake. The hull of the vessel is of brick and the upper section of timber framing and staff covering. The ship is surrounded by water, and has the appearance of being at anchor. It has all the fittings that belong to the sea-going craft, such as turrets, military mast, guns, boats, torpedo tubes, nets and booms, anchors, etc. Officers and seamen, detailed from the regular service, will man the vessel and give drills with the guns. The battery consists of four 13-in. breech-loading rifles in the two turrets, eight 8-in. and four 6-in. breech-loading rifles, 20 6-pounder and 6 1-pounder rapid-fire guns, two Gatling guns and six torpedo tubes. This imitation cruiser was designed by Mr. F. W. Grogan, architect of the naval exhibit, under the direction of Capt. R. W. Meade, U. S. N. The cost of this structure is about $100,000, and to all intents and purposes it will prove as satisfactory to visitors as if they had seen one of the $3,000,000 cruisers built by Cramp & Sons. The canals and locks between Chicago and the seashore prevent the presence of one of the ships of the new navy, even if there had been no clause in the treaty between this country and Great Britain, which stipulates that neither nation shall keep on the great lakes more naval armament than two gunboats.

Decoration.

Most of the decorative work is colossal. It is necessarily so because the surroundings would otherwise dwarf it into insignificance. Daniel C. French's statue of the Republic is 60 ft. high, and stands at one end of the main basin of the system of lagoons. Back of this is the peristyle which forms part of the casino. At the other end of the basin, behind the Administration Building, is the fountain designed by Frederick MacMonnies. The fountain represents the progress of Columbia. In a circular pond, which overflows in a series of cascades into the lagoon, is a Greek barge. On a raised dais, supported by cupids, holding garlands, is the figure of Columbia, seated in a Greek chair, and the barge is rowed by eight standing women, four on each side, representing the arts and sciences. A winged figure of fame stands at the prow and Time holds the steering oar. The statue of Diana, designed by St. Gaudens for the tower of the Madison Square Garden, in New York, has been removed from that building to the top of the dome of the Agricultural Building. All the summer men have been at work building statuary. A wooden framework was first made, to which were attached wire screens, pieces of gas pipe, laths, etc., and over this framework was laid a coating of plaster, which gradually was made to assume human shape, and on top of these immense buildings the lines of the colossal statues are very effective.

Fire Protection.

The care which has been taken to have everything in the park in keeping with its surroundings is shown in the buildings erected for fire engine houses, which are neat in design and finished with as much care as the main buildings. There are several of these two-story, staff-covered, white engine houses scattered through the grounds. They are the most visible signs of the precautions which have been taken against fire. Everything has been done to guarantee exhibitors from loss and the public from panic. The buildings are as nearly fireproof as they can be, and engines, hose carts, or chemical apparatus are provided in abundance. The grounds are patrolled by uniformed police night and day.

CIVIL ENGINEER VS. MULE.

Some time in the fifties, in Oregon, says Mr. John T. Campbell, in "Science," a party of prospectors took a mule team, wagon, and camping equipage on a prospecting tour. In order to be correct in their local geography, and to retrace their steps should they find anything worthy of a re-visit, they took a civil engineer along, who took the bearing of every course and the distance was chained.

When they gave up the prospecting enterprise, their route had been so tortuous that they decided to take the direct route for the home camp. The engineer footed up the latitudes and departures of the courses run, and made a calculation of the course home, and all struck for the home camp. When they reached the end of their course, night had overtaken them, and they found themselves, not in the home camp, but in the woods, with no objects or land-marks that any of the party could recognize.

As the engineer took no "back-sights," or check bearings, he said that local attraction somewhere in their journey had thrown him off a little but that they were in the neighborhood of the home camp. At this, the driver turned one of his mules loose, which went directly to the camp, about three-quarters of a mile distant. As the mules were not allowed to run at

large, for fear of wandering off or being stolen by Indians, this mule had never before been over that route and must have had a sense of direction. It was a joke on the engineer which he did not relish, though it had great "staying qualities."

PERSONAL.

Mr. M. F. Case, at one time Chief Engineer of the Union Pacific Ry., died at Findlay, O., Dec. 12, at the age of 67.

Mr. L. C. Fritche has been appointed Engineer of Maintenance of Way of the Ohio & Mississippi R. R., with headquarters at Cincinnati, O.

Prof. R. H. Thurston, of Cornell University, has been appointed a member of the Advisory Council of Engineering and Marine Architecture at the World's Columbian Exposition.

Mr. Wm. T. Gould, for several years past Assistant Engineer of the St. Louis Transfer Ry., St. Louis, Mo., and East St. Louis Connecting Ry., East St. Louis, Ill., has been appointed resident engineer of the Texas Central Ry.

Mr. F. W. Brown, who has been employed on the Mayfield extension of the Gloversville water-works during the past season as constructing engineer, has opened an office at 31 North Main St., Gloversville, N. Y., and will carry on a general engineering business.

Mr. William B. Cogswell has been appointed a member of the Board of Water Commissioners at Syracuse, N. Y., for the unexpired term of Mr. Peter B. McLennan, resigned. Mr. Charles Hubbard has been reappointed for the term of six years beginning Jan. 2, 1893. Mr. Cogswell is Engineer and General Manager of the Solvay Process Co. and the Tully Pipe Line Co., of Syracuse.

Mr. Joseph N. DuBarry, M. Am. Soc. C. E., and M. Inst. C. E., Second Vice-President of the Pennsylvania R. R., died in Philadelphia, Pa., Dec. 17. He was born at Bordentown, N. J., Nov. 30, 1830. In 1847 he entered the service of the Pennsylvania R. R. as a rodman, and for three years he was engaged on the preliminary surveys and location between Altoona and Pittsburg. In 1850 he was made Assistant Engineer of construction. From May, 1852, to May, 1853, he was Principal Assistant Engineer of the Sunbury Division of the Sunbury & Erie, and to the spring of 1856 he was Principal Assistant Engineer on the location and construction of the North Pennsylvania R. R. He was also an assistant engineer on the Sand Patch tunnel of the Pittsburg & Connellsville R. R. In 1856 he was appointed Principal Assistant Engineer of the Southwestern branch of the Pacific R. R. of Missouri, and in 1858 became Superintendent and Engineer of the Western Division of the Pittsburg, Fort Wayne & Chicago R. R., which was built through to Chicago under his direction. Upon the completion of this work Mr. DuBarry was made Superintendent of the Western Division, extending from Crestline to Chicago, 280 miles, and in December, 1861, he was appointed General Superintendent of the Northern Central R. R. He also superintended the construction of the Baltimore & Potomac R. R. tunnel, at Baltimore, Md. In 1875 he was appointed Assistant to the President of the Pennsylvania R. R., and in 1882 was made Third Vice-President, having supervision of all construction and improvement works, and superintended many important works. He was elected Second Vice-President in 1888.

Mr. H. Stanley Goodwin, M. Am. Soc. C. E., General Eastern Superintendent of the Eastern Division of the Philadelphia & Reading R. R., died at Bethlehem, Pa., Dec. 25. He was in his 61st year. Mr. Goodwin was best known as General Superintendent of the Lehigh Valley R. R., which position he held for many years and practically until the time of his death, although his title was changed when the road was acquired by the Philadelphia & Reading R. R. some months ago. He began his railway service in 1852 as a rodman on the Delaware, Lackawanna & Western R. R., and was Chief Assistant Engineer of that road from June, 1853, until March, 1857. For a year after that he was Principal Assistant Engineer of the Honduras Interoceanic Ry. From November, 1858, to June, 1860, he was Resident Engineer of the Western Division of the Pittsburg, Fort Wayne & Chicago R. R. During the early years of the war he was Superintendent of the Catawissa R. R., and from April, 1863, to April, 1866, he was Chief Engineer of the Northern Central R. R. He then moved to Bethlehem, and from April, 1866, to December, 1882, was General Eastern Superintendent of the Lehigh Valley R. R. For the last ten years he has been general Superintendent of that system, and when it was acquired by the Philadelphia Reading R. R., President McLeod recognized his value and appointed him General Eastern Superintendent of the Philadelphia & Reading R. R. He was affectionately regarded by railway men and by his townspeople. He was an instructor in civil engineering at Lehigh University in 1868 and 1869, under Dr. Coppee's administration as president.

NEW PUBLICATIONS.

THE TRANSITION-CURVE FIELD-BOOK. Containing Full Instruction for Adjusting and Locating a Curve nearly identical with the Cubic Parabola in Transition between any Circular Curve and Tangent. Simplified in application by the aid of a General Table, and illustrated by Rules and Examples. Also Tables of Radii, Sines, Tangents, Versines and External Secants. By Conway R. Howard, C. E. New York, John Wiley & Sons. 12mo, flap, pp. 109, 49 pp. tables. $1.50.

THE RAILROAD SPIRAL. The Theory of the Compound Transition Curve, reduced to Practical Formulas and Rules for Application in Field-Work. With complete Tables of Deflections and Ordinates for 500 Spirals. By Wm. H. Searles, M. Am. Soc. C. E. 5th Edition. New York, John Wiley & Sons. 12mo, flap, pp. 95, 42 pp. tables. $1.50.

In our review of the above works on transition curves in our issue of Dec. 15, the price in each instance was given as $1, instead of $1.50.

SOCIETY PROCEEDINGS.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—At the November meeting Mr. P. W. Gentry, of the Richmond & Danville, described the method adopted on that road for reducing oil consumption on locomotives. Oil cans of standard capacity are furnished to each engine, and a reliable man is intrusted with the duty of filling the cans, charging the oil, and inspecting and repairing all leaky or defective cans, looking out especially for broken spouts or those with enlarged nozzles at the ends. All oil cups and oiling devices on locomotives are standard, and engineers are encouraged to keep their feed regulators working as uniformly as possible. There is also a regular system of inspecting, packing and cleaning oil holes, oil boxes and oil cups by the enginehouse crew, and this has been found absolutely essential when engines are run first in, first out.

The subject of driving boxes was then taken up and the common trouble from the breakage of the flanges on cast iron boxes was discussed. Several members expressed themselves in favor of a solid bronze box. A committee will report on this subject at the next meeting, on Jan. 9, when the reduction of oil consumption, staybolt inspection, material for piston rods, with methods of piston rod fastening and experience with compound locomotives, will also be considered. The following officers were elected: President, Pulaski Leeds; Vice-Presidents, Jas. Meehan, A. W. Gibbs; Treasurer, A. G. Steinbrenner; Secretary, S. A. Charpiot.

INDIANA ENGINEERING SOCIETY.—The annual meeting will be held at Smith Bend, Ind., Jan. 24, 25, 26, 1893. Matters of interest to county surveyors, municipal, drainage, railway and road engineers, will be sdicussed. The meetings will be held at the University of Notre Dame. Everett B. Vawter, of Lafayette, Ind., is Corresponding Secretary.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Dec. 21, Mr. J. F. Crowell in the chair, a paper on "The Shone Hydro-Pneumatic System of Sewerage," was read by Mr. U. H. Broughton, engineer for this system in the United States. The Shone system was very fully described in our issue of Aug. 4. By it the sewage flows through small pipes to ejector chambers, and is discharged thence automatically to the outlet by compressed air acting directly upon the sewage. It uses a minumum of water, and the apparatus is so arranged that no strainers are required; hence it is claimed to be much less troublesome than pumps. The system is very effective in the drainage of large buildings, where the basements are below the level of the sewers in the streets. There is an absolute barrier in such cases from a reverse flow of sewage or sewer gas from the street to the building. A case as mentioned of such an installation having been in use in Chicago for 2½ years without a single stoppage. Mr. Broughton described the system as applied to the drainage of Rogers Park, Ill., a suburb of Chicago, containing an area of about 1,100 acres, a considerable portion of which lies but 4 to 8 ft. above high water in the lake. There are 9.6 miles of sewers on the combined system, 3.7 miles of storm water drains, and 3.7 miles on the Shone system. The latter drains 214 acres, divided into three sections. The pipe sewers are all 8 ins. diameter, and the joints were made by using, first, a hempen gasket, then Portland cement mortar forced in with a wooden rammer, and then pressing more mortar in with the fingers until the joint was full. No covering was allowed until the mortar was set, and after all house connections were made a test for the leakage through 9,200 ft. of sewer gave only 15 gallons per min., and this was due to seepage at the manholes. The sewers were started at 6 ft. below grade, and at the ejectors were 14 ft. below. Each ejector has a capacity of 300 gallons, and there is one in reserve at each station. The station most remote from the air compressor is 5,070 ft. distant. There are 1⅛ miles of light cast iron pipe for the air; and the cost of the 3.7 miles of sewers, with air pipe, air compressing machinery, and ejector chambers, was $52,400, from which 10% should be deducted for discount on assessment warrants.

The system at the World's Columbian Exposition at Chicago, provides for between 3,000 and 4,000 water-closets, urinals, and wash basins. There are 26 ejector stations, varying in capacity from 60 to 600 gallons per min., and having a united capacity of 17,000,000 gallons in 24 hours; and this is said to be a larger plant than would be required for the removal of the sewage of any city in the United States, with ten exceptions. The minimum grade is 1 in 250. Vitrified sewer pipes 2½ ft. long, and with deep sockets, are used. There are 5 miles of cast iron pipes 2 to 10 ins. diameter, laid at an average depth of 4½ ft., and 4.8 miles of cast iron sewage discharge pipe, 6 to 30 ins. diameter. The maximum lift of the sewage is 67⅝ ft., and the maximum total head pumped against is 107⅝ ft. The air pipe line was tested to 90 lbs. after laying without appreciable loss, and the pressure maintained will be 47 lbs. to the sq. in. There are four wrought iron receiving tanks 32 ft. diameter and 55 ft. high, in which the solid matter will be precipitated by chemicals, and afterward pressed into cakes and burnt. The effluent will be run into the lake.

In the discussion Mr. Saunders referred to an arrangement proposed by him for Plainfield, N. J., by which the sewage would flow to collecting chambers, and the liquid matter be forced by air pressure into subterranean water channels, below a stratum of clay, so that no pollution of the surface end would result. Mr. Croes, however, thought this a very unsafe and undesirable method of disposal. Mr. Fteley thought there was danger of clogging of the valves and consequent bursting of the chamber and overflow of sewage, and Mr. Stearns was disposed to favor steam pumping for forcing the sewage to the outfall. Mr. Broughton stated that the Shone system has proved very reliable in service, and possesses the advantage over pumping that no screening is required. The estimated cost for a complete plant for a large city averaged $1.25 per lin. ft. of pipe.

COMING TECHNICAL MEETINGS.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Jan. 2. Secy., C. L. Annan, City Engineer's Office.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Jan. 3. Secy., Chas. S. Howe, Case School.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Jan. 3. Secy., W. Hallibarton.
WESTERN SOCIETY OF ENGINEERS.
Jan. 4. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 4. Annual meeting, Jan. 18, 19. Secy., F. Collingwood, 127 East 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
Jan. 4. Secy., Arthur Thacher, Odd Fellows' Building.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Jan. 6. Secy., E. K. Smoot, 903 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Jan. 6. Secy., O. Von Geldern, 719 Market St., San Francisco.
NORTHWEST RAILROAD CLUB.
Jan. 7. Union Station, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Jan. 7. Secy., F. D. Jones, Helena.
SWEDISH ENGINEERS' CLUB.
Jan. 7. Secy., P. Valentine, At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago Secy., John Erl son.
ENGINEERS' CLUB OF PHILADELPHIA.
Jan. 7. 1122 Girard St. Secy., L. F. Rondinella.
WISCONSIN POLYTECHNIC SOCIETY.
Jan. 9. Secy., M. F. Schinke, City Hall.
ENGINEERS' CLUB OF KANSAS CITY.
Jan. 9. Secy., Waterman Stone, Baird Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
Jan. 10. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
DENVER SOCIETY OF ENGINEERS AND ARCHITECTS.
Jan. 10. Secy., Geo. H. Angell, 35 Jacobson Block.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
Jan. 10. Secy., Parker N. Black, Capitol Block.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Jan. 11. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Jan. 11. Secy., F. M. Curtis, O. C. R. R., Boston.
ENGINEERS' CLUB OF MINNEAPOLIS.
Jan. 12. Secy., F. W. Cappelen, 1628 Hennepin Ave.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Jan. 12. Secy., Edward Mead, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
Jan. 12. Secy., O. H. Landreth, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Jan. 13. Secy., D. W. Meeker, St. Paul.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Jan. 17. Secy., R. H. Clark, Pittsburg.
WESTERN RAILWAY CLUB.
Jan. 17. Rookery Building, Chicago. Secy., W. H. Marshall.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Jan. 18. Secy., S. E. Tinkham, 36 Broomfield St.
MICHIGAN ENGINEERING SOCIETY.
Jan. 17, 18, 19. Annual meeting at Lansing, Mich. Secy F. Hodgman, Climax, Mich.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Jan. 19. Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.
NEW YORK RAILROAD CLUB.
Jan. 19. Secy., H. G. Prout, 73 Broadway, N. Y.
ENGINEERS' CLUB OF CINCINNATI.
Jan 19. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO
Jan. 19. Secy., C. F. Franson, Portland Block.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Jan. 20. 201 Washington Building.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 20. Secy., C. H. McLeod, Montreal, P. Q.
CENTRAL RAILWAY CLUB.
Jan. 25. S. W. Spear, E. Buffalo, N. Y., Iron Works.
INDIANA ENGINEERING SOCIETY.
Jan. 24, 25, 26. Annual meeting at South Bend, Ind. Secy., E. B. Vawter, Lafayette, Ind.
AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 21, etc. Annual meeting, Montreal, Que. Secy., R. W Raymond, 6 Burling Slip, New York, N. Y.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York. Entered at the Post Office, New York City, as Second Class Matter.

VOL. XXVIII. THURSDAY, DECEMBER 29, 1892.

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, } ASSOCIATE EDITORS
M. N. BAKER, F. P. BURT,
GEO. H. FROST.....BUSINESS MANAGER

SUBSCRIPTION RATES: One year, $5.00; 6 months, $2.50; 4 months, $2.00; single copies 15 cents. To all foreign countries in the Postal Union, add $2.08 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. They should send both the old and the new addresses. No club rates are allowed.

The date when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance. No other receipt is sent unless requested.

ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

Advance summaries of the records of tracklaying collected at this office show that not far from 4,100 miles of new railway line were built in the United States during the calendar year 1892. These figures we believe to be substantially correct and certainly not exaggerated, although it is to be remembered that in order to publish our summary at such an early date many of our reports must necessarily be sent in some days before the close of the year, and tracklaying on lines where work is in progress has to be estimated. Delayed reports may also cause some slight changes from the above total, but, on the whole, the final and revised figures will probably not vary more than 100 miles either way from the figures given, and probably not so much. This addition of 4,100 miles of new railway during the year just passed brings the total railway mileage of the United States up to 174,700 miles or about 45% of the total railway mileage of the world. In a future issue we shall publish a detailed list and map showing the length and location of each line of new railway built, and shall leave the detailed discussion of the railway work of the year until then. The very important part which long extensions by the older companies play in the railway work of 1892 should, however, be noted. Our records show that 1,583 miles, or 39.4% of the total track laid has been built by nine companies. The longest of these extensions is the Pacific extension of the St. Paul, Minneapolis & Manitoba R. R. to Puget Sound, 558 miles in Montana, Idaho and Washington. Among the other more noteworthy additions by single companies are: The Lehigh Valley and Adirondack & St. Lawrence, in New York, 58 miles and 150 miles respectively; the Wabash in Ohio, Indiana and Illinois, 161 miles; the Burlington & Missouri River, in Nebraska and Wyoming, 124 miles; the Minneapolis, St. Paul & Sault Ste Marie, in North Dakota, 88 miles; the Norfolk & Western, in Virginia and West Virginia 128 miles, and the Chicago, Rock Island & Pacific, in Nebraska, Indian Territory and Texas, 148 miles. Aside from these few long extensions the track has nearly all been laid on short branches and extensions to develop local interests or afford shorter and more favorable routes for existing traffic.

The comprehensive paper discussing methods of keeping railway lines clear of snow, which we print on another page, sets forth some facts and principles which deserve attention. As the author points out, the trouble experienced from snow on a railway will vary inversely with the preparations which have been made for keeping the line clear. The Canadian roads, which have the heaviest snowfalls to meet, do not suffer from snow blockades more frequently than roads in sections of the United States where the regular snowfall is much lighter, and where severe snow storms are so rare that adequate preparations are not made to meet them.

It will be noticed that the author does not assign a large place to the machine plows in the work of snow clearing. For clearing out a deep cutting, or a road or side track covered with packed snow to a depth of several feet, they are invaluable, and will do more and better work than a large gang of hand shovelers; but the cut or siding should not have been allowed to drift full. "Keep the road open" is the great principle to be followed in fighting snow. There is power enough in the locomotive equipment of almost any railroad to keep its tracks open in any storm, if it is only rightly applied. The chief reason why blockades occur is that too little attention is paid to this important principle. Heavy freights are kept moving when their engines should be pushing snow plows. Again there is probably too much reliance on push plows and too little on engine nose plows for clearing snow. Because of the labor in taking off and putting on, engine nose plows are usually made too small and too light. If properly made they will break their way through a drift of considerable depth, and if made with a square nose, as they should be but seldom are, they can run into a drift at good speed with very little danger. By cutting down freight trains to a size which locomotives can handle easily at good speed, and putting engine nose plows on the front of all locomotives on the road, traffic can be kept moving and the road can be kept open.

Of course it is needless to say that an even snowfall of any depth which ever occurs can be handled readily by the engine nose plow. It is the drifts which cause the blockades on a road. But if plows are kept moving over the road at frequent intervals the drifts will not have time to form so deep that the plow cannot break through them. So far as possible snow fences should be used to prevent the formation of drifts. The few places where bad drifts will form in spite of these precautions should be well known to the section gang and should be carefully watched when the snow is drifting. A little work in cutting off the edge of the drift, or cross-trenching it if necessary, will keep it in safe shape for the locomotives to buck.

To show how little locomotive equipment is really necessary to prevent blockades, it will certainly be agreed that an engine movement over the road once in five hours will prevent the formation of drifts so deep that a large nose plow cannot go through them. This means on a road 100 miles in length only 960 miles per 24 hours (remembering the fact that an engine must move part of the time over track which it has just gone over). At an average speed of only 20 miles per hour and 12 hours service per day for a locomotive and crew, this work can be done by four locomotives. Since the regular trains moving over the road will do a considerable part of the work of keeping the road clear, it is apparent that a very small locomotive equipment put on the road and kept in motion will prevent a snow blockade.

The city of Brooklyn stands in continual danger of a water famine, owing to the very small margin between the pumping capacity of its waterworks and its consumption of water. Mr. Robert Van Buren, M. Am. Soc. C. E., Chief Engineer of the Department of City Works, has just renewed his urgent appeal of May 11, 1892, for increased pumping facilities, and he now asks in addition for the construction of more storage ponds and a third water supply conduit about 13 miles in length. The total daily pumping capacity of the works is 80,000,000 gallons. For the four months, June to September, 1892, the average daily pumping was about 71,000,000 gallons and the average daily consumption about 72,000,000 gallons, the deficiency being made up from water stored in the distributing reservoirs. In the period named the maximum daily consumption was as high as 81,000,000 gallons. Mr. Van Buren's recent recommendations had hardly been written when the shaft of one of the 15,000,000-gallon pumping engines broke, leaving an available capacity during the four or more weeks necessary for its repair of only 65,000,000 gallons. The old brick conduit, which broke Nov. 21, 1891 (Eng. News, Nov. 28 and Dec. 5, 1891), entirely cutting off water from the pumps for about 56 hours, is now paralleled by a smaller cast iron conduit, so that one danger has been lessened, that of having no water to pump. But the danger noted already remains, that of not having available engines to pump the water. So far as can be learned, the lack of prompt action in enlarging the Brooklyn waterworks lies with the city aldermen, for the annual and special reports of Mr. Van Buren and the recommendations of Mr. John P. Adams, Commissioner of City Works, show that the necessity for extensions has existed for several years. Last summer the mayor of Brooklyn, Mr. D. A. Boody, tried to call the city council together to take steps to secure more pumps, but was unable to do so. It has been hinted that the proposed methods of letting the contracts or supervising the work deprive the city aldermen of all opportunity to secure direct pecuniary benefit. Whether or not this be true is not to be judged here, but Brooklyn certainly has an unusually low margin between its consumption and pumping capacity.

Since the above was written the New York Tariff Association, for determining the fire insurance rates of greater New York, have passed the following resolution, which is said to apply to all buildings in Brooklyn, except dwellings:

> Resolved, That until such time as the fire department in the city of Brooklyn shall have been improved to the satisfaction of the fire underwriters, expressed through this association, there shall be added to all rates 25%. That such addition be made separate, in the form of a "rider," the wording of which shall be promulgated by the manager of the association.

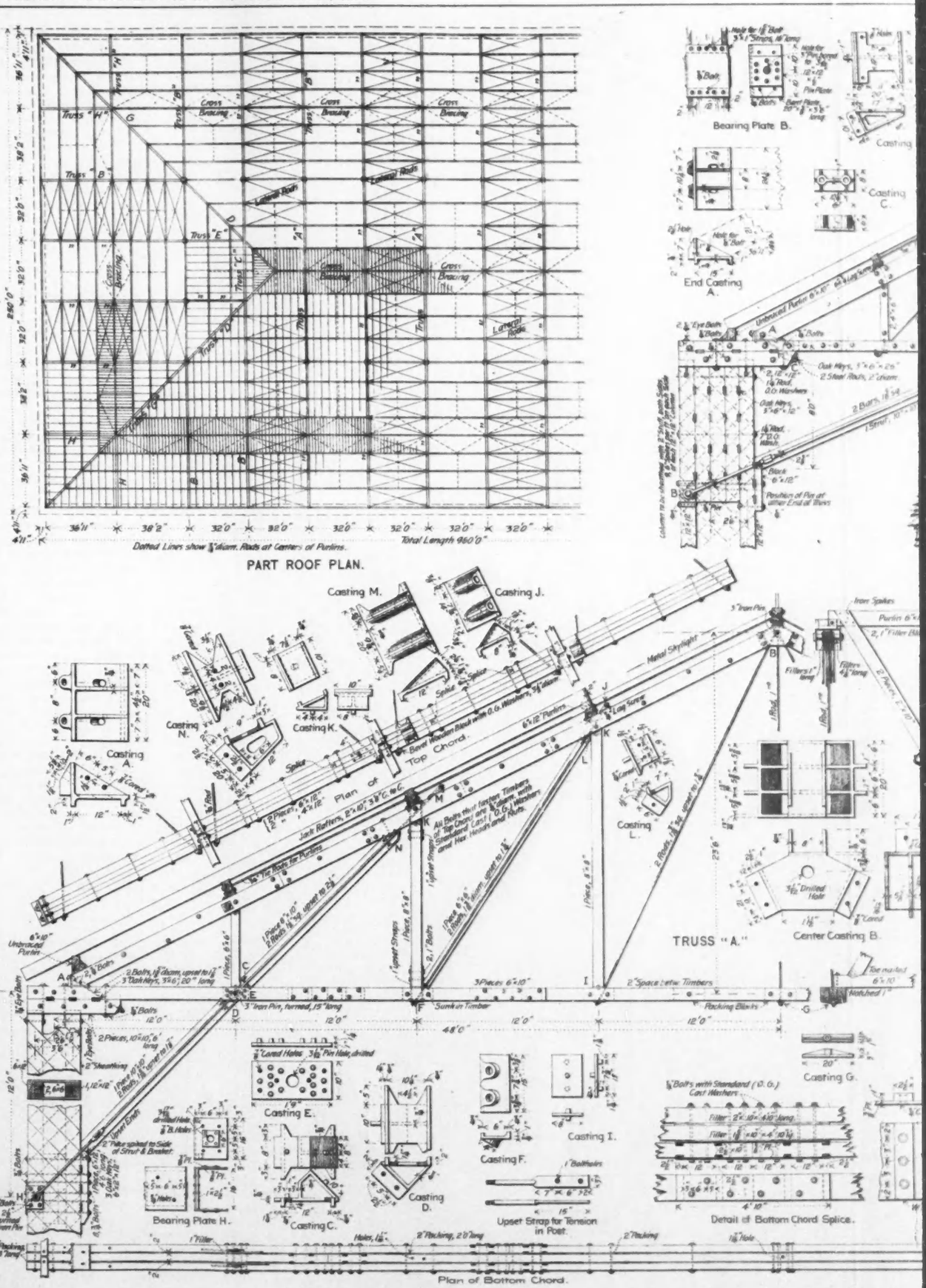
No reference is made in this resolution to the condition of the water-works, the inefficiency of the fire department, it is said, through its too intimate connection with politics, receiving the full blame for the large advance in insurance rates. It is evident that with a poor fire department the danger of a failure or partial failure in the water supply of the city is greatly increased.

Another question of "engineering ethics" has come to our attention in connection with the proposed new impounding reservoir for the city waterwork at Altoona, Pa. Some time ago the city voted $220,000 for improving the water supply. The Water Commissioners engaged Mr. C. W. Knight, C. E., of Rome, N. Y., to prepare plans and specifications for a new reservoir. As proposed this reservoir will have a capacity of 360,000,000 gallons, against 60,000,000 gallons capacity in the present storage reservoir, which was built in 1887-8, with Mr. Knight as engineer. At a recent meeting of the Select Council a letter was presented from Mr. Harvey Linton, City Engineer, which contained the following, and was referred to a committee:

> Under the act of May, 1889, governing cities of the third class and authorizing the election of a city engineer, ordinance 204 is in force. The ordinance directs that the city engineer shall devote his entire time and attention to the service of the city, having the regulation or control of the public streets, buildings and sources of water supply of the city. This clause seems to have been overlooked by everyone interested in the plans for a new impounding reservoir. It is probable that Mr. C. W. Knight, the engineer selected by the Water Commissioners to prepare plans, etc., for the new reservoir, has no knowledge of this provision of ordinance 204, but before the beginning of actual work upon this reservoir, I think it is advisable to lay this matter before council.

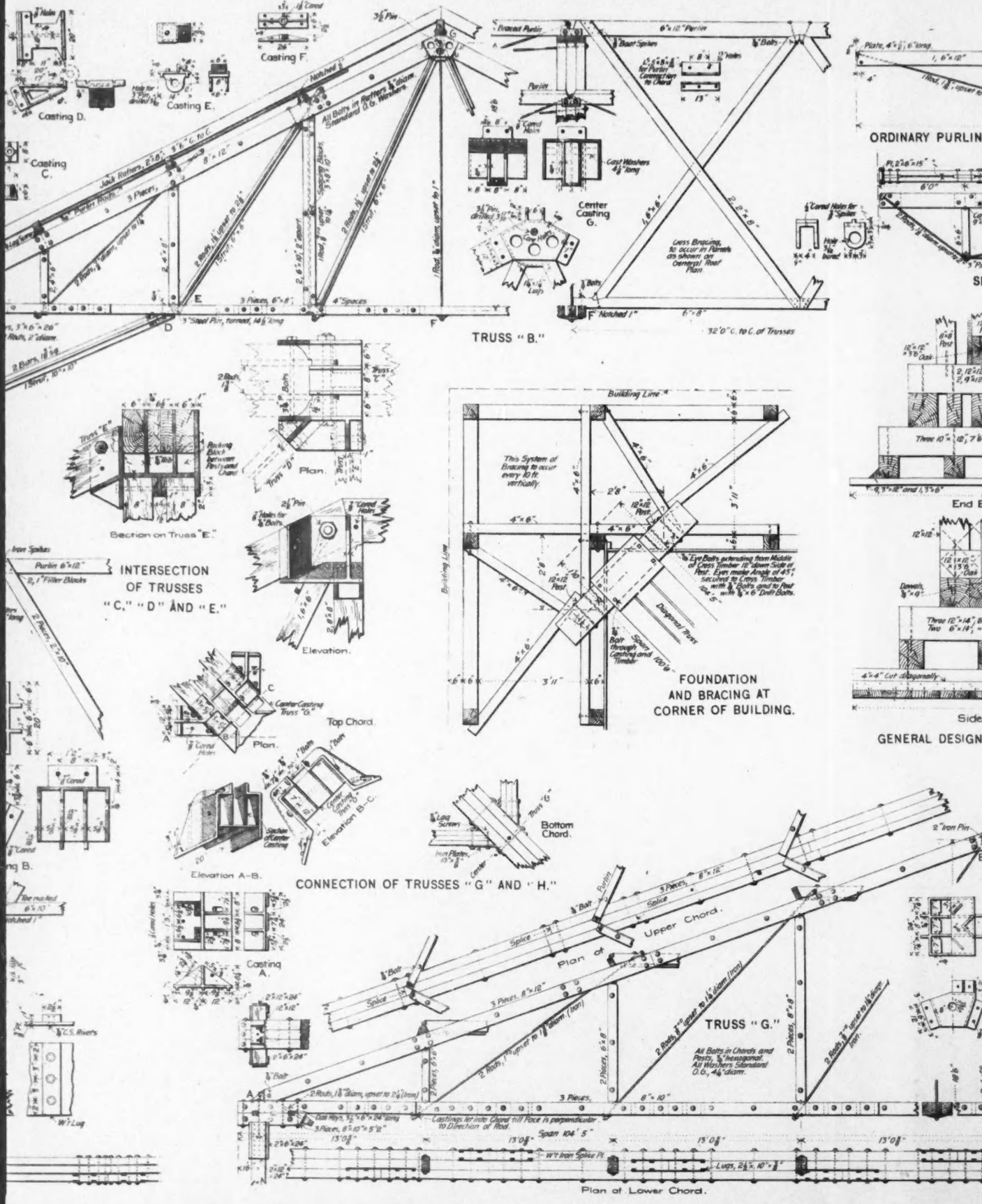
If the phrase "having the regulation or control of the public streets, buildings and sources of water supply" was designed to give the city engineer supervision over the water-works of the city, so far as engineering work is concerned, it is evident that City Engineer Linton and Mr. Knight are placed in unpleasant relations to each other. If the phrase "sources of water supply" is intended in its more technical sense as meaning the stream or body of water from which the supply is drawn then certainly the city engineer should be consulted in connection with a new storage reservoir. Mr. Linton's report as city engineer for the year 1891 shows that during the year he was called upon to do the necessary engineering work connected with the laying of new water mains, so that his duties have been recognized as extending to this class of water-works construction, and if so, why not to the doing of engineering work for a new reservoir?

The action of the Water Commissioners in employing Mr. Knight as engineer for the new reser-



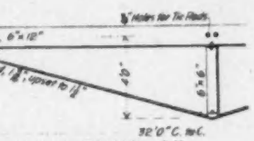
TRANSPORTATION BU

D. H. Burnham, Director of W

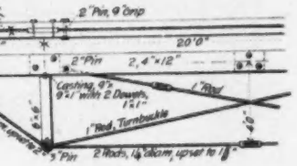


ON BUILDING; WORLD'S COLUMBIAN EXPOSITION.

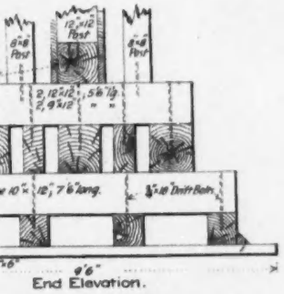
r of Works. E. C. Shankland, Chief Engineer.



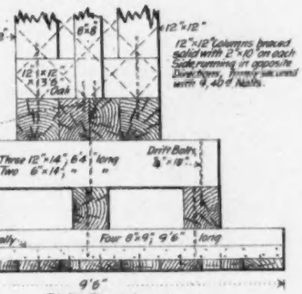
PURLIN, TRUSS "A."



SPECIAL PURLIN.

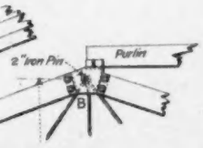


End Elevation.

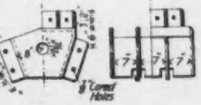

6"x6"
12"x12"
12"x12" Columns braced solid with 2"x10" on each side running in opposite Directions, 2 rows at each end with 9, 40d Nails.
12"x12"x13'6" Oak
Three 12"x14", 6'4" long
Two 6"x14", " "
Drift Bolts, ¾"x18"
Four 9"x9", 9'6" long
9'6"

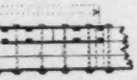
Side Elevation.

L DESIGN OF FOUNDATIONS.



Center Casting B.





CHAS. HART & SONS, LITH, 88 VESEY ST., N. Y.

voir was natural enough, both because he was employed on the reservoir built some four years ago and because it is customary for such bodies to employ an outside engineer for such work. Nevertheless if the work is properly under the supervision of the city engineer the Water Commissioners might reasonably be expected to know it. Mr. Knight doubtless accepted the engagement in good faith, as Mr. Linton states to be probably the case. The principal blame, then, seems to fall upon the rather loosely defined duties of the city engineer, or perhaps the difficulty is more accurately accounted for by the general tendency to regard a city engineer as a person employed to run levels and do ordinary work, while more important duties are to be intrusted to some outside engineer.

As yet no trouble nor conflict has arisen between these two engineers, and it is to be hoped none may. But it is obvious that each has something in favor of diverse views of the situation, which may give rise to antagonism, to the injury of both the engineers concerned, of the profession of engineering and of the interests of the city and the work. All of this risk might be saved if engineers were required by established conventions to be a little more punctilious in their treatment of each other in such matters, which would necessarily compel boards of public officials and managers of corporations to be so likewise. The constant tendency of such boards and managers is to treat their engineer, not as an officer, but as an employee, who has no further rights than to do day by day what he is told, and draw his pay therefor on pay day. This tendency is injurious to all concerned and improper. It should be strenuously resisted. But it never can be effectively resisted while engineers set a bad example by failing to show to each other the same punctilious respect which they desire that others should show to them when in office. If we are shown to a room in a hotel which some one else claims is already his, we do not ignore his claim and proceed to take possession. Good breeding requires that we shall immediately withdraw, and leave the question at issue to be decided by proper authority. In like manner, in a case like that narrated, good breeding requires that the latest comer should punctiliously insist on the removal of all doubt as to the propriety of his appointment and the extent of his jurisdiction before he accepts the engagement. The individual hesitates to do this, especially when he thinks the objection itself far-fetched (as he will be apt to do) because he desires the engagement and dislikes to seem "cranky" or "uppish" before a body of men which has small opinion of either of them except as convenient servants to do a certain class of work. He should be aided by established conventions which have the whole profession behind them.

The New Decimal Association began active operations in England in 1890 with the purpose of promoting the adoption of a decimal system of weights, measures and coinage in the United Kingdom. The prospectus for 1892 is now before us, and we notice that the general committee is decorated with the usual list of English peers, commencing with the Duke of Westminister, K. G., and ending with a half-dozen of simple lords. But among the other names appended, those of men who may be supposed to have some live interest in the promotion of this work, are a number of prominent English civil engineers, including Sir Benjamin Baker, Sir Douglas Fox, Sir Guilford Molesworth, Mr. Edward Woods, and Mr. Harrison Hayter, past presidents of the Institution of Civil Engineers.

As to the progress made, it is mentioned that the Educational Code has been amended, since 1891, so as to recommend the teaching of the metric system in the lower branches of the primary schools. Steps are being taken to obtain similar provisions in the code of Victoria and other British colonies. Effort is now being made to have a Royal Commission appointed by the present Parliament to consider the question of a decimal system in the light of recent requirements. The Congress of Chambers of Commerce of the British Empire, held in London in July, 1892, resolved that "the introduction of a decimal system of weights, measures and money, is urgently needed in order to increase our foreign trade, facilitate commerce and render elementary education more effective and less expensive." In this connection it may be said that over 150 members of the late Parliament signed a petition in favor of a decimal system, and the leading school boards have also petitioned for it, on educational grounds. The metric system is proposed for adoption by the members of the association; but they recommend that weights and measures be dealt with first and coinage afterward. This may be wise as far as foreign commerce is concerned; but to the stranger in England the absurd money notation is more puzzling than anything else, and would seem first to demand radical change. It is encouraging, however, to note some intelligent and earnest effort in the general direction of improvement; and while the United States is ahead of England both in the use of a decimal system of coinage and in more general use of the metric system under certain conditions, we can go much further than we have in simplifying our weights and measures along with the United Kingdom.

THE PANAMA CANAL DISCLOSURES.

Every day adds a fresh chapter to the history of the Panama Canal scandal in Paris, and new accusations against men once honored and powerful in government and social circles accumulate with startling rapidity. Enough evidence has been already brought forward to prove that this "poor man's canal," as Mr. de Lesseps delighted in calling it, was forced upon the people of France by a gigantic and wonderfully well organized system of fraud and corruption. And therein lies the real iniquity of the transaction. Instead of honestly and intelligently attempting first of all to measure the natural and engineering difficulties to be encountered, and to estimate the probable cost of this vast enterprise, the course deliberately selected by the promoters of the canal was about as follows: Starting with an avowedly rough preliminary reconnoissance across the Isthmus, which did not even indicate a profile and literally took no note whatever of the real obstacles in the path, steps were at once taken to popularize the scheme in France and to induce the poor farmer and petty tradesman to invest their precious savings in this work. To this end the phenomenal financial success of the Suez Canal and the prestige of de Lesseps, its succesful promoter, were used for all they were worth. Mr. Charles de Lesseps confesses in his examination that newspapers were bribed and people of social prominence subsidized for their services in booming the canal. And the evidence now pouring in shows that enormous sums were squandered in corrupting legislators and members of the highest departments of the government. How much money was thus taken from the small hoards of the poor and diverted from honest work on the canal into the pockets of schemers and dishonest officials cannot yet be stated; but the present aggregate forms a very heavy percentage of all the money collected for building the sea-level canal.

If evidence is lacking in Paris to condemn the men manipulating the home end of the enterprise, enough can be collected on the Isthmus itself to show that the one thing in which these men were least interested in was the actual and successful construction of the canal. Lack of proper surveys and plans; waste and corruption in almost every department; absolutely useless plant and unchecked extravagance in the planning and construction of hospitals, houses for officials, docks, town sites, etc., all prove the utter want of honest supervision and intelligent effort at the Paris headquarters. Many of the French engineers sent there were doubtless competent professionally and were personally anxious to promote the engineering success of the canal. But when men in Europe had to be paid or bribed with heavy commissions on the purchase of worthless plant and by concessions which were only granted to give the "concessionaires" an opportunity for pocketing profits that they did not earn, it is easy to see that the engineer on the Isthmus was not in a position to control, and we must deal lightly with him for his sin of omission. In fact, the work on the canal was managed purely as a part of the promotion scheme from Paris, and a showing of increased monthly quantities of cubic metres extracted was of more purpose in encouraging investors than honest and necessary but slower work would have been. These monthly returns were published in Paris in the official organ of the canal, and how many metres were added there, to meet a home demand, can only be guessed at. The charge is plainly made that these reports were too often fraudulent as published, and the showing of work done on the Isthmus would bear out this charge.

One of the peculiar features of this scandal is that with one honorable exception, "L'Economiste Francais," every newspaper in France seems to have been bought to promote the schemes of these unscrupulous men; one editor alone was found in all France who strove to tell the truth and to warn unsuspecting and innocent investors of the inward rottenness of Panama Canal affairs and to keep some check upon their published statements. When to the admitted corruption of the press is added the wholesale buying of ministers and men high in government places, the present righteous indignation of the defrauded French people is little to be wondered at. The existing government is itself in great danger as a result of the late disclosures, and the only safe course now is to probe this filthy mess to the bottom, and to punish every guilty man according to his misdeeds and without regard to rank or previous reputation. The one useful lesson to be learned is that deceit and corruption cannot ultimately succeed in an enterprise of the magnitude of this canal, as they should not succeed in any enterprise; and that engineers and not speculators must control the engineering features of such work. Smaller undertakings without number have been wrecked by the misapplication of this same rule; the Panama Canal fraud is only remarkable for its magnitude, and the success of its promoters in so long concealing its true condition of affairs.

AMERICAN COMPETITION IN SHIPBUILDING.

Our London contemporary, the "Engineer," in its issue of Dec. 2, has something to say on the above head, in comment upon our remarks in our issue of Oct. 6, 1892. After quoting and commenting on certain other portions of our article, it takes up our statement that since 1860, when we led England in total tonnage, our energies had been too much absorbed in internal development to give much attention to shipping. The substance of its remarks in this relation are as follows:

> But was there a smaller continental interior to be opened up and developed in 1860 than there is to-day in America? If the diversion of their energy to opening up the country will account for the smallness of their shipbuilding and shipowning enterprise in 1892, how did it happen that for many years prior to 1860 they were actually gaining upon us in tonnage? There must surely be some other cause operating in the matter than an interior in course of development. Does Mr. Cramp at Philadelphia, or Mr. Roach at Chester, Pa., build ships at a disadvantage because somebody else a thousand miles away is profitably engaged in farming upon virgin soil? If the United States output of iron now exceeds that of England, why are they not making more of that iron into ships? No one questions the mechanical skill of their workmen nor the scientific ability of their naval architects, but everybody knows that almost the only mercantile shipbuilding carried on in the United States is in the production of vessels for their rivers, lake, and coasting trade; and everybody on this side of the Atlantic believes that were it not for their navigation laws, which preclude other than American built ships from being employed in their coast traffic, we should do a large share of the shipbuilding and a large share of the carrying in that trade also. How then can Engineering News believe the United States shipbuilders when they say they are able to build Atlantic liners at less cost than ourselves? If they can do so, why do not they? No, no! there is a reason for everything, and for this thing among the rest; and we will tell Engineering News what that reason is. The United States are, it is true, producing an enormous amount of iron and steel annually, but were there not a high protective tariff on iron and steel they would not produce nearly so much, and what they did turn out would not fetch so much money. We would supply them with a portion of their requirements, and at a price that would cheapen the remainder. We venture to say that, despite all that has recently been done with public money in the production of a war fleet in the United States, the American shipbuilder will never be able to build ships at a price to compete with this country, while wages and materials are dear.

This sounds plausible, but it affords us opportunity to note some interesting facts showing how little there is in the argument. It is true that there is a "smaller continental area" to develop now than in 1860. Therefore, we are now beginning to turn our attention to shipbuilding once more. But although there was more to do in 1860-65, there was less chance to do it, our railway system being then inchoate, and therefore it was up to that time a small drain on our resources. In other words, although settlements for "farming upon virginal soil" had been expanding quite rapidly prior to 1860-65, the kind of "development" which demands and absorbs large amounts of capital, like the building of railways and great cities, opening of mines and factories, etc., had then hardly begun in our continental interior.

But what have we done since 1865 in developing our railways alone? We have expended over $8,000,000,000 (£1,600,000,000) in hard cash in adding 135,516 miles of new railway and improving the 35,085 miles which we had in 1865.

In the meantime, what does the boasted (very justly boasted) increase in the British marine amount to in substantially the same period? (1860-1888 instead of 1861-1891). According to Mulhall, it has amounted to an addition of only $450,000,000 (£90,000,000) to the value of the British mercantile marine, being less than 18% of our investment of railways. Therefore, we have only to spend for five years, as much on shipping, as we have averaged for the past 26 years on railway construction, and we shall have added as much to our mercantile marine as has been added to the British marine in the last 28 years. Hence the justice of our position that the apparent decadence in the American marine since 1860 has really been only a temporary lull in one direction of our progress, because all the ground that we have lost can be more than recovered in a very few years.

For there is another still more amazing fact than those narrated, and one too little known. Besides our enormous investment in railways, and despite what has seemed to us and to others the "terrible depression" of our shipping interests, we have actually added more tons to our mercantile marine since the war than England has in the same period, and nearly half as much steam tonnage! Here are the figures, those for the United States being taken from the official "Statistical Abstract of the United States" for 1891, (p. 233) and those for Great Britain from Mulhall's "Dictionary of Statistics:"

Tons of Mercantile Shipping.

U. S.	Steam.	Sail.	Total.
1865	367,189	1,212,805	1,579,994
1891	2,016,264	2,668,495	4,684,759
Incr. 26 yrs.	1,649,075	1,455,690	3,104,765
Great Britain.			
1860	502,000	4,158,000	4,660,000
1888	4,350,000	3,115,000	7,465,000
Incr. 28 yrs.	3,848,000	-1,043,000	2,805,000

Nor is our tonnage swelled to any large extent by non-seagoing craft. It is distributed as follows:

	Tons.
Atlantic and Gulf Coast	2,780,683
Pacific Coast	440,858
Great Lakes	1,154,870
Western rivers	308,348
Total, as above	4,684,759

The Great Lakes are practically inland seas, and even more dangerous to navigate than the ocean. The river craft only are really dissimilar from ocean service and they train sailors and engineers for sea service. Of the above total only about 1,000,000 tons are engaged in foreign ocean commerce, against about 1,500,000 tons in 1865. This decadence, though in itself small, is great when the enormous increase in the total commerce is kept in view; but we have only to add about 2,500,000 of ocean steam tonnage to our present fleet to have a mercantile marine which will be somewhat stronger on the ocean than the present British marine.

This we could build in about 2½ years by investing as much in it annually as our average investment in railways since the war!

If these figures seem too good to be either true or probable, the reader has only to look back over the course of pig iron output for the past five or six years to see a much greater interval closed and overlapped as rapidly.

But our contemporary asks, if our iron output is so large why do we not build more ships? We can tell it. Partly because this iron output is going into works of internal improvement to an extent of which it has no adequate conception, and which return bigger interest than any nation earns on ships, and partly because after the ship is built it is subjected to an antiquated burden of state and national taxation which British ships are free from. It seems incredible that it should be so in so progressive a nation, but so it is.

As for the tariff predictions of the "Engineer," we will not enter into any political discussions, but this at least we feel safe in predicting:

1. The tariff on all raw materials, and especially the metals will be heavily reduced.

2. The reduction will not be pushed so far nor so fast as materially to reduce our own output, or let in any large amount of foreign importations.

3. A very small amount of such importations will raise prices abroad and reduce them here until we shall stand on an equality in cost of raw material, which we have been approximating to rapidly in recent years, in the iron line at least, without any change in tariff except to raise it.

4. Wages will not go down, nor will they need to. Our higher wages are for the most part accompanied by a correspondingly larger output per man, owing to greater use of machinery and more efficient labor.

5. We shall then enter in earnest once more into competition for the world's trade, and our impression is that there will be some interesting developments.

The "Engineer" itself, in its issue of Nov. 18, referred editorially to the fact that the German transatlantic lines are taking away a good deal of the traffic from the English lines, and stated that there was a real danger to British supremacy on the Atlantic, and we offer the suggestion that while the Collins Line failed in the early days of transatlantic steam service, some other American line or lines may at a future date enter into very close competition with the English lines. Our contemporary's fear for the future of its transatlantic steamship traffic is shown by the following extract from its remarks:

We still have a hard fight to make if we would try to regain the undisputed supremacy at one time enjoyed. If we stand still, we stand in danger of being swept off the Atlantic. British shipowners now-a-days have to struggle against great odds, and their profits are a fluctuating when not a minus, quantity. They do not improve their position, however, by a policy of laissez faire. Others will advance if they will not, and progress generally pays. As an example, the Cunard Line paid no dividend to its shareholders in the three years immediately prior to the building of the "Umbria" and "Etruria." Since then these popular vessels have, as practical exponents of the gospel of progress, saved the company. Arguing from this, the new steamers will doubtless yield a corresponding increase of prosperity. The North-German Lloyd is another case in point. It was only the inception of a new and vigorous policy that brought the company from the verge of ruin to the payment of a handsome dividend. At all events, we must not allow foreign steamers which call at our ports to accomplish that which the Collins Line failed to do in respect of the Cunarders. We cannot afford to be swept off the Atlantic.

LETTERS TO THE EDITOR.

THE CAUSE OF TYPHOID FEVER IN ST. LOUIS.

Sir: In a recent editorial note on the prevalence of typhoid fever in St. Louis (Eng. News, Dec. 8, 1892), I am said to have given a hint that possibly the fever germs had a Chicago origin. While I have not expressed or formed an opinion as to the origin of the late contagion, I did make a suggestion as to several lines of inquiry as to food, milk and water supplies, intimating in regard to the latter, the possibility that the assumed to take place self purification of running streams might not be complete. The health authorities of St. Louis unwisely, in my judgment, gave countenance to the assertion that our water supply was polluted, and that the pollution was chargeable to certain rendering and bone handling works, whose removal or suppression has been sought by the health authorities for a long time. What I said through the "Globe-Democrat" was a mild protest against limiting precautionary and remedial measures to this assumed, and, in fact, improbable cause. My real suspicion was that a shorter and more probable connection might be found through the food and milk supplies from the malaria infected country districts, where enough unmistakable fever has prevailed to furnish the germs.

But, aside from the local question, the broader inquiry into the completeness of self purification of running water is of exceeding importance. Every resource of science should be exhausted in the definite determination of the facts. Polluted water is disease laden; under what conditions does it become fit for use again? Returning to the Chicago sewage: It is in evidence that typhoid fever germs have survived an exposure much longer, and seemingly more favorable to their destruction, than would be required for a given element of water to travel from Chicago to St. Louis. We here have deluded ourselves with the assumption that we get Missouri River water, only, served to us, but chemical analysis a few years ago showed that Missouri River and upper Mississippi waters were easily distinguishable, and that the water at our pumping station showed a blending of the characteristics. For a long time I held to the view that time, distance traversed, aeration, and especially dilution, would render a once sewage polluted water safely potable; and I therefore favored the projected Chicago drainage scheme; I now question much whether the discharge of crude sewage into inland rivers can be tolerated, irrespective of the size of the rivers. Lest I be misunderstood, I add, if Chicago cannot discharge crude sewage into the Illinois without endangering the health of the river towns and St. Louis, neither can St. Louis so discharge into the Mississippi to the injury of the lower river cities. As the population of the country becomes more dense, we must guard the water supply against even suspicion of sewage taint.

Robert McMath.

St. Louis, Mo., Dec. 16, 1892.

(As Mr. McMath says, "Every resource of science should be exhausted in the definite determination of the facts" regarding the self purification of running water. Engineers and scientists, like Mr. McMath, are, in the light of recent biological investigations, losing the confidence in self-purification which was so general not long ago. The discharge of crude sewage into inland waters is being slowly checked in this country, as it has been for some years in England, and within the past two or three years the purification of sewage has been discussed or proposed in a comparatively large number of towns and cities. Shall we make sewers of our rivers? is a question which is already being discussed, and must receive universal attention with the rapid growth of our cities. Shall a city with a water supply of fair purity be forced to abandon it and secure a new supply at large expense because of sewage pollution from towns above it, or shall the polluting towns be required to divert or purify their sewage?

It may be added that the number of deaths from typhoid fever in St. Louis during the week ending Dec. 10 is given as 93, and during the week ending Dec. 17 the greatly reduced but still heavy mortality of 48 deaths from this disease was reported.—Ed.)

LOCATING TRANSITION CURVES.

Sir: Space in your valuable paper is requested in which to deduce equations required in locating true transition curve, to show that Mr. Wellington's curve does not coincide with it, and to try to show error in his demonstration.

Required a curve whose radius of curvature varies inversely as length measured from point of tangency.

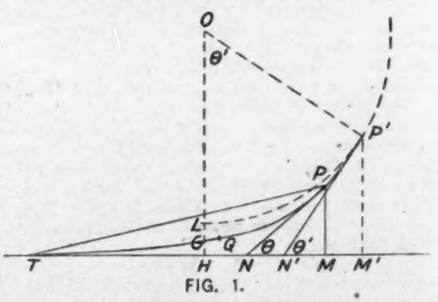


FIG. 1.

(Not drawn to scale).

T M' is a tangent, T G P P¹ is the transition curve beginning at T and terminating at P' with O P' for final radius.

P is any point on the curve.

x = T M, h = T P y = P M K = constant.

θ = angle P N M between tangents at T and P.

S = length of T G P.

R = radius of curvature at P.

By the requirement R varies as $\frac{1}{S}$ (1).

Then $$R = \frac{K}{S} \qquad (2).$$

But $$R = \frac{ds}{d\theta}$$

Therefore $$\frac{ds}{d\theta} = \frac{K}{S}$$

or $$S\,ds = K\,d\theta$$

Integrating, $\frac{1}{2} S^2 = K\theta$

or $S = \sqrt{2K\theta}$ (3). This is its intrinsic equation.

From (3) θ varies as S^2 (4)

From (2) and (3) $S = 2R\theta$ (5) or twice a circular arc of same radius and angle.

Equation (5) shows that the curve is a spiral which may terminate with any radius, R, after consuming any angle, θ, from 0 to infinity. But in this and many other interesting properties we are not at present concerned. We want for a railway curve only a portion of this spiral at its beginning.

To refer the curve to rectangular axes:

$$dx = ds \cos\theta$$
$$dy = ds \sin\theta$$

From (3) $$ds = \sqrt{\frac{K}{2\theta}}\,d\theta$$

Then $$dx = \sqrt{\frac{K}{2\theta}}\,\cos\theta\,d\theta$$

$$dy = \sqrt{\frac{K}{2\theta}}\,\sin\theta\,d\theta$$

Integrating, $$x = \sqrt{2K\theta}\left(1 - \frac{\theta^2}{5^2} + \frac{\theta^4}{9^4} - \frac{\theta^6}{13^6} + \ldots\right) \quad (6)$$

$$y = \sqrt{2K\theta}\left(\frac{\theta}{3^1} - \frac{\theta^3}{7^3} + \frac{\theta^5}{11^5} - \frac{\theta^7}{15^7} + \ldots\right) \quad (7)$$

Let series in (3) be represented by q and the one in (7) by p. Then substituting for $\sqrt{2K\theta}$, its value in (3), we have

$$x = Sq \quad (8)$$
$$y = Sp \quad (9)$$
$$h = \sqrt{x^2 + y^2} = S\sqrt{p^2 + q^2} \quad (10)$$

Angle P P T M $= \tan\frac{y}{x} = \tan\frac{p}{q}$ (11)

Let a table be prepared in which columns A, B, C, D and E contain respectively θ, p, q, $\sqrt{p^2+q^2}$ and $\tan\frac{p}{q}$

To locate the curve in the field: First decide on a value for S', which substitute in (5) to find θ'.

Then to locate by offsets from tangent T M, use (4), (9), A and B, if distance is measured on curve; or (4), (8), (9), A, B and C, if distance is measured on tangent.

To locate by deflection angles use (4), A and E.

To locate by long chords use (4), (10), A, E and D.

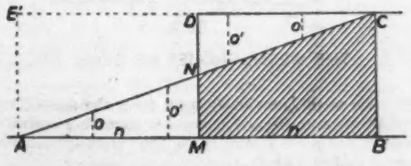
By (4), (10), A, E and D and a table of sines and cosines, it can be readily located by offsetts from any long chord.

The calculations required in all, except the last, of the above methods, can be done mentally by the engineer rapidly enough to keep the chainmen busy.

Members of a compound curve can be connected by an arc of this curve That, however, will not often be required; for, generally, two dissimilar transition curves with or without a simple one will fit the ground as well.

Mr. Wellington's curve in Engineering News of Feb. 8, 1890, does not coincide with this, for his offset or y varies as S^3, while in this it does not. Equation (7) shows that for y to vary as S^3 all of the series, except its first term must disappear. That, of course, cannot be except θ be zero, and zero substituted for θ in (3) makes S zero. Since the two curves are not identical, and if the above equations are correct, there must be error in demonstrations of Feb. 8. To show this error, an effort will now be made.

Fig. 7 is here reproduced:



In proposition 3, it is properly shown that MB = ½ AB, that is, that M, the extremity of *rectified* circular arc falls on middle of rectified transition curve BA; but that does not warrant the conclusion that, when these straight lines, BM and BA, are curved into their respective positions, P'L and P'Q, Fig. 1, the middle point of transition curve and extremity, I_0 of circle, will be in line with O.

If in Fig. 1 we make R = 1,000, S = 2,000 and θ consequently equal to 1 or 57°.3, it will be found that Q, the middle point of curve, is more than 25 ft. from G, where Mr. Wellington would have it.

Again, the fact that O' = O, in Fig. 7, shows that curvature lost in arc B E of transition curve equals that gained by the equal arc A F, but does not show anything in regard to offsets, for offset is not an element in that figure.

It would seem, without investigation, that a curve located one half of it by offsets from a circular arc, the other half by same offsets, taken in reverse order, from a straight line, would at its middle point have a change in its law, or, in other words, the two parts would conform to different laws, that is, be different curves.

It is admitted that Mr. W's curve is nearly right when θ and S are small, and that the calculations connected with it are simple; yet, the satisfaction felt in locating exactly right, and the fact that the calculations required in locating the true curve are simple enough, and that the calculations and accuracy are the same when the curve is extended to long distances and through great angles, where the other curve fails to be even an approximation, are considerations of such note, that they would probably cause engineers to adopt the true curve, if the scheme were elaborated and convenient tables prepared.

Yours respectfully, D. E. Hughes.

College City, Cal., March 4, 1890.

[As will be seen from the date of this communication it has been on hand for some time, awaiting opportunity and the completion of some further matter relating to the same subject. Pressure of other occupations, and in part, it must be confessed, "that tired feeling," have caused nearly two years' delay, and in justice to our correspondent we now publish his letter. It amounts only to saying that if one wants to lay out transition curves 2,000 ft. long for curves of a 1,000-ft. radius, a little calculus is necessary to do it with exactness, and methods which are quite accurate within the range of practical requirements are not so when pushed to extreme limits. This may be admitted. Similarly, ordinary methods of curve running in the field are admittedly amply accurate, yet if one should attempt to lay out a 6-in. circle on his drawing board by calling it an 1,100'-curve and running it in with a transit, he would not find it either convenient or accurate. His curve would certainly be ragged. What of it?—Ed.]

SEWAGE DISPOSAL IN AMERICA.

(Continued from p. 582.)

Medfield, Mass.

The sewage purification plant at Medfield, Mass., combines mechanical separation, or straining, with intermittent downward filtration, and treats mainly the sewage of the Excelsior Straw Works, only a few residences being connected with the sewers. The town of Medfield is on the Charles River, about 17 miles from Boston. It had a population of 1,493 in 1890 and 1,371 in 1880. It is largely an agricultural town, the exception being the straw works, which employs a large number of hands.

Vine Brook having been polluted by the drainage from the straw works, much of which came from the vats in which the straw is dyed, in which dye wood is used, a sewer was built in 1886 to divert the sewage from the brook.

The sewage disposal plant was designed by Mr. E. C. Clarke, M. Am. Soc. C. E., and constructed under the direction of Mr. Fred Brooks, M. Am. Soc. C. E. The following description of the plant is condensed from a paper by Mr. Brooks published in the Massachusetts State Board of Health Report for 1886-7 and reprinted, with slight changes, in the Journal of the Association of Engineering Societies for July, 1888.

In order to remove the dyewood from the wastes from the vats of the straw works, duplicate settling tanks and excelsior filters are provided, shown in section in Fig. 54. The filter was used nearly a year before the excelsior was changed, but meanwhile the excelsior had rotted and was nearly ready to pass, piece by piece, into the sewer. The effluent from the tanks is joined by the other sewage from the straw works, after which the sewer changes from a diameter of 4 to 6 ins. This portion of the system, with branches to houses, was built at private expense. From the end of the 6-in. pipe the town laid one 8-in. sewer, with capped branch pieces for extensions through the village. Near the filter beds the sewage enters the cesspool shown in plan and section at the right in Fig. 55, the T outlet being designed to hold back objects that float or sink until chemical or other action changes them so they will flow out uniformly upon the bed.

The outlets in the middle of the filter beds are shown in plan and section at the left in Fig. 55. The area of the filter beds is only one acre. This area is divided into four sections by embankments, three of which are about 1 ft. high, while the pipe embankment is 3 ft. high. The filtering material consists mostly of stones and gravel, from the size of a man's fist down. The natural level of the ground water being about 10 ft. below the surface, the beds are not underdrained.

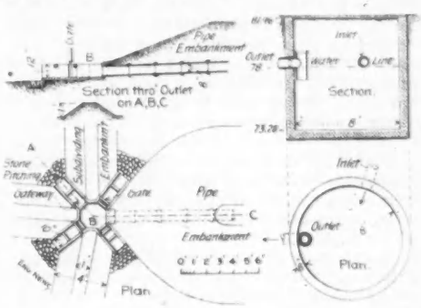


Fig. 55. Plan and Section through Sewage Outlets and Cesspool.

The average daily amount of sewage throughout the year was estimated by Mr. Brooks, the latter part of 1887, as about 32,000 gallons, it varying with the force employed and work done at the straw works. Mr. Brooks gives the probable cost of the cesspool, pipe to outlet and filter beds as about $1,000. The land was given to the town.

In a letter dated Nov. 21, 1892, Mr. Geo. W. Kingsbury, chairman of the selectmen of Medfield, gave the following information:

The average yearly cost of caring for the filter beds thus far has been about $50. The beds require plowing and harrowing once every year, and more than that if much sewage goes to them. There has been no trouble with the sludge upon the beds. The sewage runs upon each section about two days, thus giving each section about six days' rest. Surveys were being made on the above date to determine what territory could be made tributary to the works. Probably many residences will be connected with the sewers next year, in which case it may be necessary to enlarge the area of the filter beds.

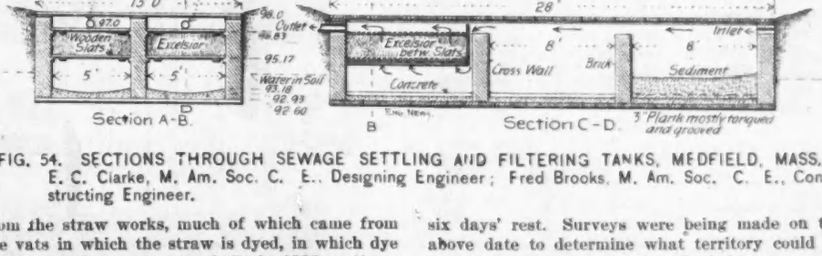


FIG. 54. SECTIONS THROUGH SEWAGE SETTLING AND FILTERING TANKS, MEDFIELD, MASS.; E. C. Clarke, M. Am. Soc. C. E., Designing Engineer; Fred Brooks, M. Am. Soc. C. E., Constructing Engineer.

SPECIFICATIONS FOR PROPOSED PUMPING ENGINES FOR THE WATER-WORKS OF OSAKA, JAPAN.

American pump manufacturers are to have a chance to bid on the furnishing of a large pumping plant for the city water-works of Osaka, Japan, a place of some 1,000,000 population. Proposals for the plant are now being asked in our advertising columns. The specifications contain some points of interest, given below.

Water is to be taken from the river Yodoganwa through intake towers to a pump well, from which it will be raised by centrifugal pumps to settling basins. From the basins the water will pass to filter beds and thence to the main pumping engines. Ordinarily water will be pumped to ser-

vice reservoirs, but direct pumping may sometimes be necessary.

There will be three sets of centrifugal intake pumps, one held in reserve, each driven by an independent compound condensing engine. Each pump must have a capacity of raising water 27 ft. at the rate of 700 cu. ft. per minute, or 7,560,000 gallons per day; for the present water will be raised only 23 ft. as the maximum, and this may be reduced to only 6 ft. in time of flood.

The engines must show a test duty of not less than 6,000,000 ft.-lbs. for each 100 lbs. of water evaporated in the boilers.

There will be five sets, one for reserve, of compound (double or triple expansion) surface condensing engines, each capable of raising 320 cu. ft. of water per minute, or 3,280,000 gallons per day 119.5 ft. through about 13,000 ft. of 26-in. main terminating in a reservoir. The frictional loss in the force main, to be added to the above, is taken at 30 ft. In addition to the above capacity, each set of pumps must be capable of raising a 20% excess of water to an additional height of 24 ft., pumping directly into the distributing mains.

The engines must be fitted with automatically variable expansion gear, such that the maximum steam expansion will be at least 12 times the volume of steam admitted to the high pressure cylinders.

Of crank-shaft pumping engines preference will be given to the three-cylinder type, with cranks at an angle of 120° with each other.

The test duty of the engines will be 10,000,000 ft.-lbs. for each 100 lbs. of water evaporated in the boilers. In the test the engine is to be run with ordinary boiler working pressure, and a pump piston speed of not more than 120 ft. per minute in ordinary working.

There will be duplicate force mains, and the pumps will be connected with each main. Air vessels will be fitted to the pumps and also to each of the force mains.

The boilers for the intake and main pumps must be of the same type and dimensions, with about one-third of the whole boiler power in reserve. They must be made of Siemens-Martin steel, or that of equivalent quality. Two strips cut lengthwise or crosswise from the steel plates must have an ultimate tensile strength of not less than 26 English tons, or 58,240 lbs. per sq. in., with not less than an 18% elongation in a length of 8 ins. Angle, tee, bar steel and rivets must stand such hot and cold forge tests as will show their fitness for the service intended. All rivet holes will be drilled, those on bent portions after bending.

The boilers may have a working pressure of from 90 to 120 lbs. per sq. in. above atmospheric pressure, the pressure to be determined by the contractor to suit the type of engine which he proposes to use. The boilers must be capable of evaporating 8 lbs. of water from and at 212° F. per pound of Japanese Takashima coal. The composition of this coal is given as follows:

	Per cent.	Exclusive of sulphur, ashes and water, per cent.
Carbon	79.26	84.43
Hydrogen	5.86	6.24
Oxygen and nitrogen	8.76	9.33
Sulphur	.11	....
Ashes	4.51	....
Water	1.50	....
	100.00	100.00

Coke, per cent., 58.01.

The contractors must leave an engineer in charge of the pumping plant for six months after its completion, this engineer meanwhile giving the attendants employed by the city full instruction regarding the working and management of the plant.

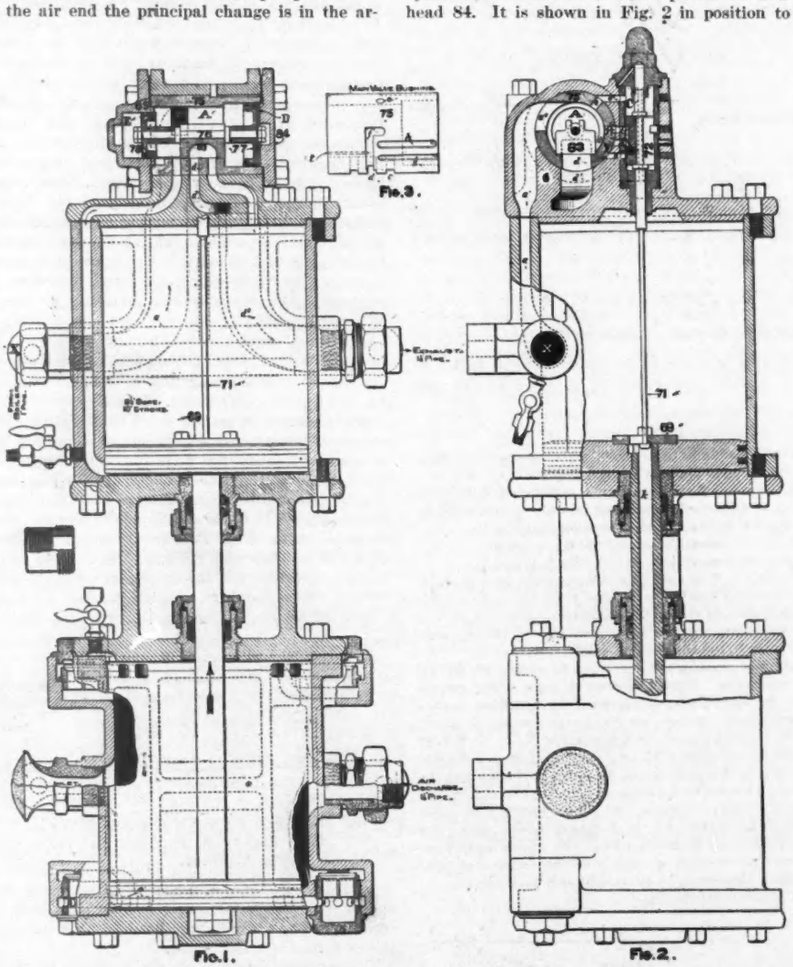
The Omaha Canal & Power Company has been inporated with a capital of $3,000,000 to utilize the hydraulic power of the Platte River. This river has an average fall of 6½ ft. per mile, says the Omaha "Herald," and from North Platte to Fremont, a distance of 245 miles, it falls 1,604 ft. By building a canal about 40 miles long, the projectors expect to obtain a fall of about 146 ft. 6 miles west of Omaha. The area of the canal would be sufficient to discharge about 1,000,000,000 gallons every 24 hours. The canal would terminate on a hilltop, and the power would be developed by turbines placed at the foot of large steel pipes leading from the canal.

A NEW WESTINGHOUSE AIR PUMP AND ENGINEER'S BRAKE VALVE.

The accompanying illustrations show a new style of air compressing pumps for use in connection with air brakes which has just been brought out by the Westinghouse Air Brake Co. The rapidly increasing use of air brakes on long freight trains has given rise to a demand for an air pump of greater capacity than the standard pump. The new air pump has a 9½-in. cylinder, against 8 ins. in the old pump, and has a capacity 65% greater. In designing this large pump the makers have made some radical changes in construction, designed to facilitate and cheapen the cost of repairs, and to economize in the use of steam.

The new air pump has its valve motion wholly within the top head of the steam cylinder, so that to repair the valve motion the top head alone requires removal. A spare top head can at once be put on in its place, and thus a delay due to trouble with the pump may be made very short. The number of parts of the valve motion is considerably less, and they are so designed as to be more durable than those in the standard 8-in. pump.

At the air end the principal change is in the arrangement of the air valves. Each valve has a separate case, and all the valves are of the same size. Thus it is necessary to carry only one kind of valves in stock for repairs. An air strainer has been provided for the inlet opening of the pump intended to catch dust and cinders and prevent them from entering the cylinder.



NEW AIR COMPRESSING PUMP WITH 9½-IN. CYLINDER. THE WESTINGHOUSE AIR BRAKE CO.

The description of the pump is as follows:

The valve motion consists of two pistons, 77 and 79, of unequal diameter, mounted on opposite ends of a rod and holding a D slide valve, 83, between them. This valve provides for the distribution of the steam to the upper and lower sides of the main steam piston. The steam is admitted to the pump at X, where a suitable stud and nut permits the direct attachment of the pump governor. By the passages a and a^1 and the port a^2 the steam passes to the slide-valve chamber between the two pistons. The piston 77 having the greatest area, the two pistons and the slide-valve which moves with them are forced to the right. This is the position shown in Fig. 1, in which the steam passages are open to the lower side of the piston and the exhaust passages are open to the upper side.

Fig. 3 is an outside view of main valve bushing, 75 showing the several ports and steam passages therein, of which port t communicates between chamber E in the main valve head 85 and exhaust passage f^1 and hence is in constant communication with the outside atmosphere, relieving the pressure on the surface of main valve piston 79 exposed to the pressure in chamber E. A reversing valve, 72, operates in chamber C, in the center of the steam cylinder head, steam being supplied thereto from slide-valve chamber A through ports e and e^1. This reversing valve is moved by a rod 71, extending into space k of the hollow main piston rod. The duty of this valve is that of admitting steam to and exhausting it from space D, between main valve piston 77 and the head 84. It is shown in Fig. 2 in position to exhaust the steam previously used from the space D through port h (Fig. 3), port h^1, reversing valve cavity H and ports f and f^1 to the main exhaust ports d and d^1 and d^2.

It will at once be apparent that the steam in chamber A is exerting a force in both directions, but the total force toward the right is greater, owing to the difference between the areas of the pistons. This effect, however, is reversed, when the main piston, approaching the upward termination of its stroke, strikes the shoulder j of the reversing valve rod 71, forcing the rod and its valve 72 upward and causing the admission of steam from chamber C to chamber D through ports g and g^1 (Fig. 3). The pressure on both sides of main valve piston 77 is thus balanced, and the

steam in chamber A, acting upon the effective area presented to it of main valve piston 79 forces it to the left. Live steam is thus again admitted to the upper side of the main steam piston, forcing it downward until at the lower termination of its stroke the button head on the lower end of the reversing valve stem 71 comes in contact with reversing valve plate 69, again moving reversing valve 72 to the position shown in Fig. 2, and completing the cycle of its movement.

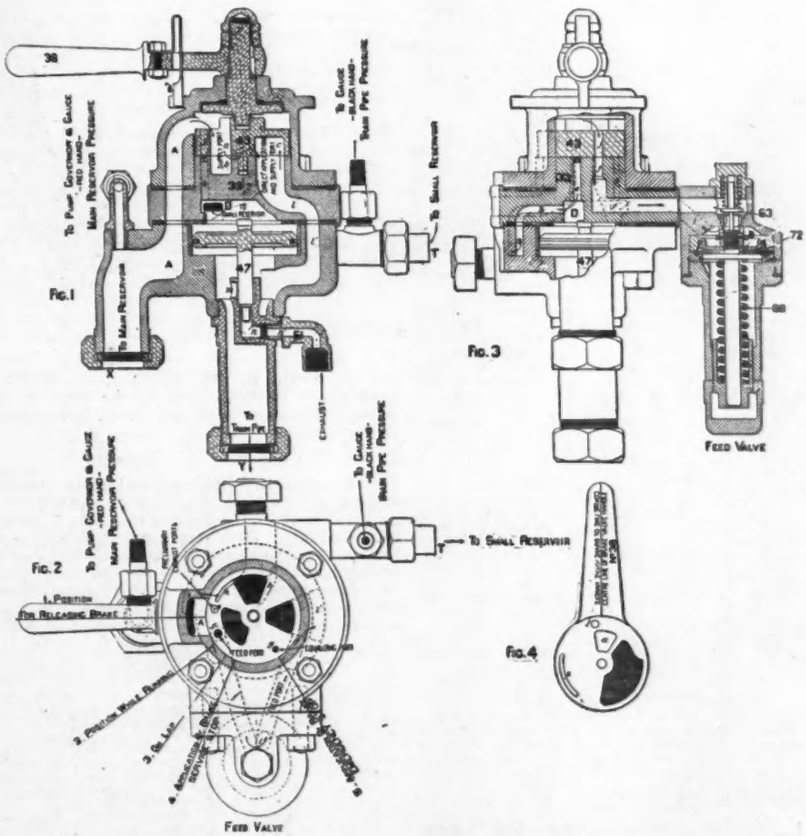
As the main steam piston moves, the air piston mounted on the same rod moves with it. The lift of the air valves is about 3-32 in. A given volume of compressed air at a given pressure will be produced by this pump with about 20% less steam consumption than with the standard 8-in. pump.

The new engineer's brake valve of the Westinghouse Co., which we also illustrate, is designed especially to secure a greater uniformity in train pipe pressures than has heretofore existed. The new valve, when in "running" position, automatically supplies air to the train pipe until 70 lbs. pressure is reached, provided the pressure in the main reservoir is 70 lbs. or more, and then automatically cuts off the supply. As soon as leakage at any point reduces the train pipe pressure, the valve begins to supply the deficiency from the main reservoir. An excess pressure of 20 lbs. in the main reservoir is a necessity with the old valve before air will pass from the main reservoir to the train pipe.

With the new valve the only duty of the pump governor is to regulate the degree of excess pressure in the main reservoir. As this may and often should be varied within considerable limits, it is not essential that the governor be sensitive to small variations in pressure. With the old type of valve the train pipe pressure is regulated by the pump governor, and a large part of the variations from the standard pressures are due to imperfect action of the pump governor. With the new valve it is stated that trains of ordinary length can have the brakes readily released by moving the handle to the running position, and this is preferable for short trains, as the train pipe pressure cannot then be raised above 70 lbs., as may occur if the valve is placed at release position and there is considerable excess pressure in the reservoir.

It will be seen that this valve is moved and handled exactly like the pattern now in general use, so that no additional instructions to enginemen or changes in the method of operation are required when the new valve is applied. The following brief description of the method of operation of the valve will make its construction clear.

While the handle is in position 1, "For releasing brakes," air from the main reservoir enters the brake valve at X, passing through ports A,A, thence through port a in the rotary valve 43 to the port b in its seat 33, thence upward into cavity c of the rotary valve, and finally to ports l and l^1 and the train pipe at Y. Port j in the rotary valve and e in its seat are in register in this position and admit air to chamber D above equalizing piston 47, and passing thence through ports s and s, charges the small equalizing reservoir connected at T. The train pipe and auxiliary reservoirs of the brake apparatus being charged, the handle 38 of the brake valve being moved to 2, "Position While Running," ports a and b and j and e are no longer in communication, and air then reaches the train pipe through port j in the rotary valve 43, and ports f and f^1 in its seat 33. It passes thence through feed valve 63 to port i, ports l and l^1 to the train pipe, and continues to flow thereto until the pressure in chamber B upon diaphragm 72 exceeds the resistance of spring 68. The diaphragm and its attachments are then forced downward, and feed valve 63 closes until the train pipe pressure, by leaks or other causes, is reduced below 70 lbs. The valve 63 is then again automatically pushed open by the diaphragm rising, and the train pipe pressure is replenished. Equalizing port g is now in communication with chamber D, maintaining train pipe pressure therein, through ports l^1, l and cavity C in the rotary valve 43.



THE WESTINGHOUSE AIR BRAKE CO 'S NEW ENGINEER'S BRAKE VALVE.

To apply the brakes the handle 38 of the valve is moved to position 4, "Application of Brake—Service Stop," bringing into conjunction port p (a groove in the under side of rotary valve 43) and ports e and h (the latter also a groove) in its seat, causing air to any desired extent to be discharged to the atmosphere from the chamber D above piston 47 and the equalizing reservoir, through the large direct application and exhaust port k, thus reducing the pressure above piston 47 and causing that in the train pipe below to force it upward from its seat, permitting air to flow from the train pipe through ports m, n and n^1 to the atmosphere through exhaust connection 51. The desired reduction of pressure in chamber D being made, the handle of the valve is moved backward to position 3, "On Lap." It must be borne in mind that after the handle of the valve has been moved to lap position, air will continue to flow from exhaust fitting 51 until the pressure in the train pipe has been reduced to an amount approximating that in chamber D. Ordinarily a reduction of 6 to 8 lbs. pressure by the gage from chamber D is sufficient to apply the brakes in the first instance slightly, and will cause a corresponding reduction of train pipe pressure by the rising of piston 47, which latter, when such reduction has taken place is automatically forced to its seat by the preponderence of pressure on its upper surface from air remaining in chamber D.

The release of the brakes is effected by moving the valve handle 38 to "Position for Releasing Brake," causing air from the main reservoir to again freely flow to the train pipe, as explained above, forcing the triple valve pistons to release position and exhausting air used in applying the brakes, and recharging the auxiliary reservoirs. While the handle of the valve is in this position a "Warning Port" of quite small size causes air from the main reservoir to be discharged to the atmosphere with considerable noise, attracting the engineer's attention to his neglect to move the valve handle to "Running Position." The engineer must move the handle of the brake valve from position 1 to position 2 prior to the accumulation of the maximum pressure of 70 lbs. allowed in the train pipe, so that the feed valve attachment may properly perform its functions of governing train pipe pressure; otherwise the privileged pressure in the train pipe may be considerably augumented, which must be carefully avoided.

For an emergency application of the brakes the handle 38 of the brake valve is moved to the extreme right, position 5, "Application of Brake Emergency Stop," "when direct application and exhaust port" k and "direct application and supply port" l are brought into conjunction by means of a large cavity c in the under surface of the rotary valve 43, thus admitting of the discharge from the train pipe of a large volume of air to the atmosphere, causing the quick action of the brakes. A reduction of 20 to 25 lbs. pressure in the train pipe is sufficient to apply the brakes to their maximum, and any further reduction of pressure is consequently a waste of air.

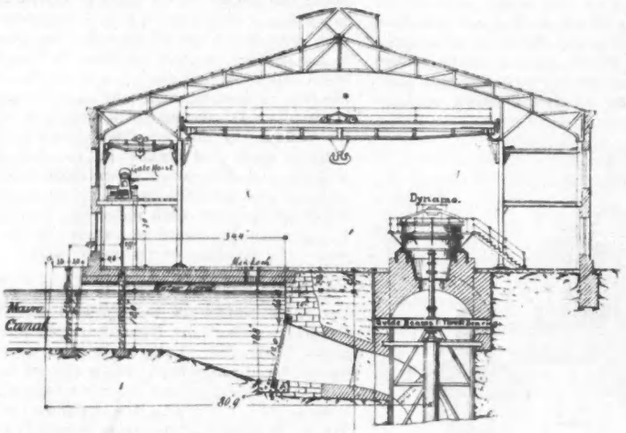
By preparing a diagram on tracing cloth or gelatine similar to Fig. 4 and placing it in a reverse position on Fig. 2, where it may be rotated on a center, the foregoing explanation may be easily followed.

The late Indianapolis road congress was attended by nearly 400 delegates. Among the many speakers present, Col. Albert A. Pope, of Boston, advocated Government aid in making better roads. Mr. G. W. Dorrell said that the "supervisor system" cost the state of Indiana $3,000,000 annually, with no benefits resulting. One estimate submitted stated that there were about 40,000 miles of roads in the state, and the speaker thought that $800 per mile expended upon them on the average would put them in good condition. This would amount to $3,200,000, or $2.50 per acre of land in the state, and distributed over 10 years this annual cost would be only 25 cts. per acre of land owned. Mr. B. L. Blair, of Indianapolis, spoke of the road-making material in the state, and he found that limestone, stone from boulders, or gravel, are at the disposal of road-makers in the various sections of the state. The congress was made a permanent organization under the name of the Indiana Highway Association, and resolutions were adopted recommending that certain laws be enacted, providing for 10-year 5% road bonds; the assessment of railway property located within 2 miles of an improved road; the amendment of the free-gravel road-law; the simplification of existing road-laws, etc.

THE NIAGARA FALLS POWER TUNNEL.

In our issue of Jan. 23, 1892, and in preceding issues all the main facts have been given as to the utilization of the water power at Niagara Falls. Since the Niagara Falls Power Co. has acquired rights on the Canadain side of the river some changes in the method of distributing power have become necessary, though much still remains to be done in fixing details.

The present plan proposes to use power generated by turbines of from 2,500 to 10,000 HP., mounted in suitable shafts; and this power is to be generally transformed into electric power by coupling dynamos directly to the vertical shaft of the turbines. In Fig. 1 is shown a section of the machine house and turbine shaft, as designed by Mr. Frank C. F. Knaak, of the Cataract Construction Co., and differing in some respects from plans already published in this journal. The principal change is the placing of the turbine shaft directly over the tail race, much simplifying construction.



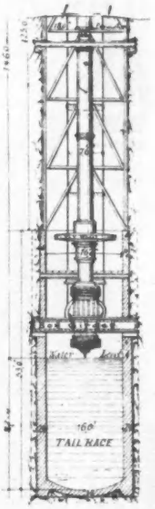


Fig. 1. Section of Machine House and Turbine Shaft.

Fig. 2 shows a section of the main tunnel as constructed. The grade in this tunnel is 7%, and at the outlet, for a distance of 200 ft., the tunnel terminates in a reversed curve of long radii. This 200 ft. is lined on the sides and invert with soft steel plates fastened to a cross system of latticed girders of iron, imbedded in concrete. We are indebted to "Der Techniker" for the cuts here shown.

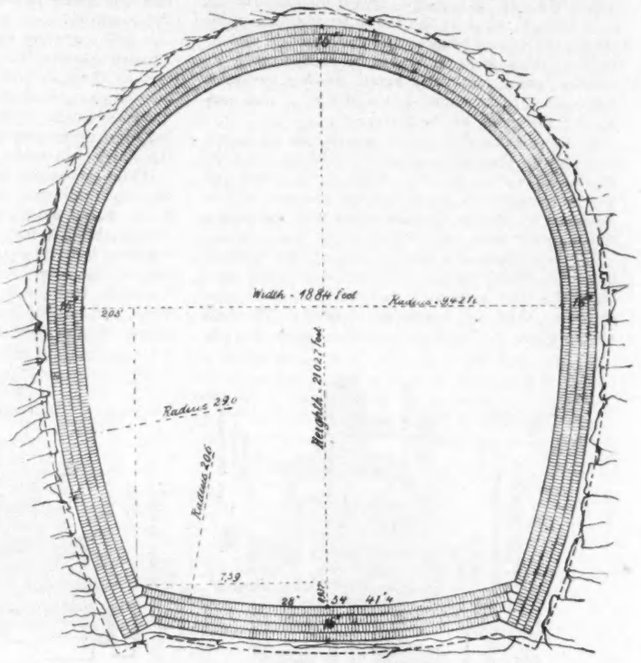


FIG. 2.—SECTION OF MAIN TUNNEL.

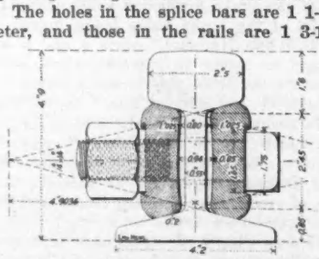
STANDARD RAIL AND TIE PLATE OF THE INDIAN STATE RAILWAYS.

On some of the earlier railways of India the conservative influence of English engineers was shown by the adoption of the double-headed rail, involving much useless metal for the tracks of railways with comparatively light traffic. Rails of this section are still in use on some of the Indian railways, but for the Indian State Railways a 75-lb. flange rail has been adopted as standard. The section of this rail is illustrated herewith, and its dimensions are given in the accompanying table, together with those of the 75-lb. rail of the Adirondack & St. Lawrence Ry. and the 75-lb. mean section prepared from the average dimensions of the individual sections recommended by the members of the committee of the American Society of Civil Engineers (Eng. News, March 21, 1891). The dimensions of the Indian rail are scaled from a lithograph section, for which we are indebted to Mr. J. Parker, Director General of Stores, India Office, London.

Dimensions of 75-lb. Steel Rails.

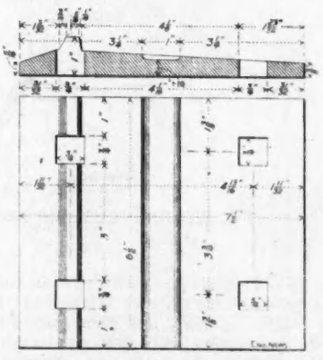
	Ind. St. Rys.	A. & S. L. Ry.	Am. S C. E
	Ins.	Ins.	Ins.
Height	4 15/16	5	4 9/16
Width of base	4 3/16	4 3/4	4 5/16
Width of head, top	2 1/4		2 7/16
Width of head, bottom	2 1/4	2 5/8	2 7/16
Slope of side of head	Vert.	1/16 to 1	Vert.
Depth of head	1 5/8	1 5/8	....
Height of web	2 7/16	2 3/4	....
Depth of base	7/8	7/8	....
Thickness of web	9/16	17/32	....
Height to center of bolt hole	2 7/16	....	....
Radius of top of head	12	14	12
" " top corners of head	3/8	1/4	1/4
" " bottom corners of head	1/4	1/16	1/16
" " top fillets	1/4	1/2	1/4
" " bottom fillets	1/4	3/16	1/4
" " corners of base	1/4	1/16	1/16
" " sides of web	Vert.	14	Vert.
Fishing angles of head and base	14°	14°	13°

The joints possess some peculiar features. They are spliced by steel plain splice bars, or fish plates, rolled with a groove in the outer side, and weighing 27½ lbs. per pair. The bearing surfaces are about ⅝ in. wide on top and 9-16 in. on the bottom, but that of the bottom could easily be increased. The splice bars are very short, 1 ft. 7½ ins. long, with five 1-in. bolts spaced 4 ins. c. to c., the center bolt passing through notches in the ends of the rails. The holes in the splice bars are 1 1-16 ins. diameter, and those in the rails are 1 3-16 ins. diameter. The bolts have heads 1¾ ins. square and hexagonal nuts with plain washers.

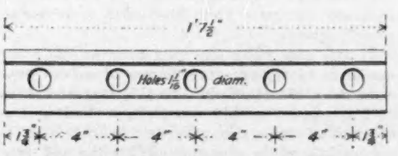


Section of Joint. New Standard 75-lb. Rail; Indian State Railways.

Wrought iron tie plates are used, 7½ × 6½ ins., with a rib on the upper side to take the outward thrust of the base of the rail, and prevent shearing and wearing of the outer spikes. The rail seat is inclined in order to give the rail an inward cant, in accordance with European practice, to fit the coning of the tread of the wheels. There are four spike holes, ¾ in. square, in the plate.



Wrought Iron Tie-Plate for New Standard 75-lb. Rail; Indian State Railways. (Scale ¼.)



Fish Plate for 75-lb. Rail; Indian State Railways

The fiber-graphite, self-lubricating bearings, described in our issue of May 19, 1892, are being imitated abroad by the Carbold Oilless Bearing Co., Ltd., 7 Carteret St., Westminster. This firm, however, claims to use powdered steatite (soapstone) as the binding material instead of wood pulp, which is the substance used by the Fiber-Graphite Mfg. Co., of Philadelphia. According to a brief description in "Engineering," the graphite after mixture with a certain proportion of steatite is compressed by a hydraulic press and afterward baked. It is then "slightly heavier than ordinary carbon, but much tougher and capable of resisting violent shocks."

Why powdered soapstone should confer tenacity or

resilience on powdered graphite is not apparent on this side of the water; and it seems likely that the Carbold Co. mixes something with their graphite of which they did not inform our contemporary. The results claimed for the material in service are very similar to those claimed for fiber-graphite; but the Carbold Co. seems to have gone farther in its application, and claims to have bearings in successful use on street cars.

The great steamship companies of the world arranged in order of total tonnage, are given by a German paper as follows:

Name of company.	Number of steamers.	Total tonnage.	Average tonnage of vessel.
North German Lloyd.....	66	221,603	3,358
British Indian.....	91	199,096	2,188
Messageries Maritimes.....	62	192,631	3,107
Peninsular & Oriental.....	48	187,684	3,910
Compagnie Generale Transatlantique.....	64	165,635	2,588
Florio Rubattino.....105		161,687	1,540
Wilson Line.....	84	147,162	1,752
Hamburg American.....	44	136,669	3,106
Allan Line.....	42	130,156	3,077
Austrian Lloyd.....	76	123,365	1,623

The Cunard, White Star, Inman and other prominent transatlantic lines do not appear at all in this table, it will be seen. Whether they belong to it or not, we cannot say, but we believe the list is intended to be complete as far as it goes, and that all other lines fall below the minimum of 123,365 tons.

The latest case of water pipe corrosion caused by electric currents is reported from Washington, D. C. Lieut. J. O. Manson, of 407 New York Ave., has reported to Engineer Commissioner Rossell that the galvanized iron service pipe on his premises corrodes, and becomes miserable in a short time. An investigation is to be made.

The electric railway between Singapore and Johore has been completed. The track is 3-ft. gage, laid with 20-lb. rails, and 2,400 ties to the mile. Overhead wires are used, and the motor car is of an experimental type, with chain gearing from the motor to the car axles.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

LEHIGH VALLEY.—The branch line from Coplay to Egypt, Pa., 1½ miles, has been completed.

WILKESBARRE & EASTERN.—Work is making good progress on this railway from Wilkes Barre to Stroudsburg, Pa. Tracklaying has been commenced near Wilkes Barre.

PHILADELPHIA & READING.—A report is going the round of the newspapers that this company and the Wabash R. R. Co. are making arrangements to connect their lines between Toledo, O., and Harrisburg, Pa., by building or purchasing a connecting railway. There seems but little visible foundation for the rumor, however.

BALTIMORE & OHIO.—Surveys are reported to be in progress for a shorter line between Miller's Grove and Wilson, Pa. The work will include a tunnel about 1,700 ft. long.

PHILADELPHIA & READING.—A press dispatch from Buffalo, N. Y., says: "The Reading is making plans to carry out at once its contemplated extension of coal-handling facilities here. The plans involve a cost of $1,000,000. When the changes are made the company will have facilities for shipping 10,000 tons more of coal a day than now. It is proposed to dredge out a second canal between the lake front and the company's present long canal on the Tifft Farm. A water trestle now stands between the present canal and where the new canal will be, and back of this is a storage dock. Another large trestle and a storage dock will be built, the trestle to cost about $8,000, and the dock $100,000. This dock will hold 10,000 tons of coal, and will be long enough for two vessels to load at the same time. The trestle will be built wide enough for four tracks. These additions will give the Reading local facilities for handling and shipping their output to the West and to Canada. The entire work will probably be finished so that shipments from the new dock can begin on June 1 next. The company has at present facilities for storing 340,000 tons of coal at the Tifft farm, East Buffalo and Cheektowaga.

ORFORD MOUNTAIN.—This line has been inspected by the officers of the Provincial Government, and will soon be opened for traffic from Eastman to Kingsbury, P. Q., about 26 miles. Sixteen miles of the line have been built this year.

LOUISVILLE, NEW ALBANY & CHICAGO.—This company will make extensive additions to its passenger and freight equipment during the coming year, and will continue the improvements of its track and roadbed.

Projects and Surveys.

CHICAGO, EVANSTON & INDIANA.—Articles of incorporation for this company have been filed. The company proposes to construct a road from a point on Lake Michigan, near the northern city limits of Chicago, westerly and southwesterly, crossing the canal between the western limits of Chicago and the western limits of Cook County, thence south and east, intersecting the state lines of Indiana and Illinois, in Cook County. The capital stock is $5,000,000, and the incorporators are: J. W. Taylor, John G. Watson, Newton, P. R. Hatch, John Davis and David Williams.

MONTEREY & STREE'S RUN.—Chartered to build a railway from Monterey, Allegheny Co., Pa., to a point on the Wheeling Division of the Baltimore & Ohio R. R. Pres., Robt. A. Carter, Pittsburg, Pa.

MANCHESTER BRANCH.—Chartered in Maryland to build a railway from Manchester to Maple Grove, Md. Among the incorporators are: Jacob A. Frederick, Wm. H. Shower, Edward Omsler and Chas. J. H. Gauter.

Southern.—Existing Roads.

HODGENVILLE & ELIZABETHTOWN.—This company has ordered a survey to be made for an extension from Hodgenville to Elizabethtown, Ky.

WHEELING TERMINAL.—The prospects are that this terminal railway at Wheeling, W. Va., will soon be extended to Benwood.

Projects and Surveys.

POTOMAC & APPALACHIAN.—Chartered in West Virginia to build a railway from a point in Mineral Co., W. Va., through Grant and Hampshire counties to Franklin, Pendleton Co. The principal offices will be at Franklin, W. Va.,

DRY FORK.—A charter was issued last week to this company, organized for the purpose of constructing a railway, to begin near Bretz, in Tucker Co., W. Va., and extend southwest along Cheat River, through the valley of either Glade Fork or Dry Fork to the headwaters of Greenbrier River, in Pocahontas County and thence, southery, through Pocahontas and Greenbrier counties to the Chesapeake & Ohio Ry., near Caldwell, in Greenbrier Co., with branches up the Red Creek and tributaries of Cheat River. The principal office will be at Bretz, Tucker Co., and the incorporators are: Martin Lane, Wilmington, Del.; Levi C. Condon, Baltimore; John L. Hummell, Philadelphia; J. B. Rees, Rees' Tannery, W. Va.; R. F. Whitmer, Philadelphia, Pa.

PENSACOLA, ALABAMA & TENNESSEE.—A meeting of citizens was recently held at Pensacola, Fla., to consider a proposition submitted by Henry McLaughlin and C. R. Desham for the construction of a railway from Pensacola, Fla., to Memphis, Tenn. The projectors asked $100,000 in aid of the enterprise, and agree to commence work by Jan. 10, and have 10 miles completed in 60 days.

Northwest.—Existing Roads.

DULUTH, PIERRE & BLACK HILLS.—A press dispatch from Pierre, S. Dak., dated Dec. 21, says: "General-Manager Ward, of the Duluth, Pierre & Black Hills Ry., who is in Chicago to-day telegraphed that the deal is closed and capital advanced by which the grade will be completed, ironed, equipped, and operated from Aberdeen, via Pierre to Rapid City, a distance of 200 miles. This involves an immediate cash outlay of $4,000,000. Contracts for timber and rails are being let, and it is the intention to push the enterprise to completion in the shortest possible time. This is the first railway to span the western half of the state over the lately ceded Sioux reservation lands, and give the Black Hills connection with the balance of the state. Some of the leading capitalists of New York city are backing the deal."

MILWAUKEE & NORTHERN.—The recently completed extension of this road from Channing to Sidnaw, a distance of 47 miles, was formally opened Dec. 20, by a party of officials of the road, including Third Vice Pres. E. P. Ripley; Gen. Supt. W. G. Collins, his assistant, E. W. McKenna, Supt. H. M. Bell, General Freight Agent J. J. Coleman, and others. The extension gives the company an entrance to Ontonagon over its own line, instead of having to use another road for part of the distance and then strike its own line. The extension will be open for regular traffic Jan. 1. It is now stated that the road will be extended to Calumet from Sidnaw in the coming season. Preliminary surveys are already made for part of the way, and the right of way secured.

BRAINERD & NORTHERN MINNESOTA.—The first 40 miles of this road from Brainerd, Minn., has been completed and accepted. The road thus obtains the bonus of $100,000 in bonds voted to aid its construction by Crow Wing Co., Minn.

DAKOTA, WYOMING & MISSOURI RIVER.—Pres. W. T. Coad states that he has made arrangements for pushing forward the work on this line, and that the grading will be resumed in a short time west of Rapid City, S. Dak.

Projects and Surveys.

CHICAGO & MISSISSIPPI RIVER.—Articles of incorporation have been filed in the office of the Secretary of State of Illinois, by this company. It is proposed to construct a railway from Chicago to a point on the Mississippi River, in Mercer Co., and from a point on said line in Stark Co., to a point on the Mississippi River in Pike Co. The principal office is to be in Chicago, and the capital stock $10,000,000. The incorporators are: D. W. McCord, S. M. Dunton, N. J. McMillan, G. F. Tibbits, and C. M. Lahm, all of Chicago.

Southwest.—Existing Roads.

GULF, NEWPORT & NORTHERN.—The contract for the construction of this railway from Alligator Head, on Matagorda Bay, to Victoria, Tex., has been let to Dave Burns, of San Antonio, Tex.. The distance is about 45 miles. The road will be extended to San Antonio at an early day. The contractor will commence work about Jan. 1, employing a sufficient force for its early completion.

Projects and Surveys.

LUFKIN & SOUTHEASTERN.—This company has been chartered to build a railway in Texas. The line is to run from Lufkin, in Angelina Co., to Rockland, in Tyler; capital stock, $250,000. Incorporators; W. H. Bonner, J. H. Kurth, B. F. Bonner, A. W. Henderson, Samuel Weiner, Jr., J. J. Bonner, Melvin Glenn, A. M. Denman, W. M. Vinson and E. J. Mantotte, of Angelica, Tex.

Rocky Mt. & Pacific.—Existing Roads.

SPOKANE FALLS AND NORTHERN.—It is reported that the contract has been let for the construction of the Nelson and Ft. Sheppard R. R., from the International line to Nelson, B. C., 60 miles.

COLORADO MIDLAND.—It is announced that the Midland Terminal road will be running into Cripple Creek, Colo., by Feb. 1. About three-fourths of the grading between Divide and the town of Midland, and about one-half between Midland and the mining camp is completed. The ties are already on the ground; the rails are being rolled and the rolling stock is about to be contracted for.

Projects and Surveys.

NEVADA SOUTHERN.—The route of this road, noted last week, is as follows: From Goff, San Bernardino County, Cal., west of The Needles to Good Springs, Lincoln County, Nev., via Goff, Von Trigger, Manvel, Vanderbilt, Ivanpah in San Bernardino county, Cal., and State Line and Good Springs, Lincoln County, Nev., with branch lines from Manvel to the New York mining district, and from State Line to Mesquite Valley, over the State Line Pass. The length of the road is 100 miles. L. E. Blake, of Denver, President of the road, has recently returned from New York City where he is reported to have made arrangements to bond the road for $15,000 a mile at 5%, the Metropolitan Trust Co. to be trustee of the bonds. The company expects to complete 50 miles by Feb. 1, 1893, and a contract for the shipment of 100 tons of ore a day from that terminus has been signed. The work will not be done by contract. The directors are: L. E. Blake, of Denver; Demetrius G. Scofield, of San Francisco; Walter F. Crosby, of Colorado Springs; Frank L. Morgan and Otto Amsden, of Needles, Cal., and William L. Beardsley and George C. Manley, of Denver. R. S. Seibert is General Manager.

NORTH FORK AND MINARET.—Chartered in California to build a railway from a point on the North Fork of the San Joaquin River in Tp. 7 S. R. 22 E. northeast to the centre of Sec. 30, Tp. 7 S. R. 22 E. Among the incorporators are T. Stewart White, Sec.; Grand Rapids, Mich.; W. B. Birmingham, Oakland, Cal.; and Thos. Friant, Pres., Grand Rapids, Mich.

SALT LAKE & DEEP CREEK.—Chartered in Utah to build a railway from Salt Lake City to Muncey, Nev., 220 miles.

KASLO & SLOCAN.—Hon. John Hendry, of New Westminster, B. C., one of the principle owners of the townsite at Kaslo, B. C., and President of the railway company, has had engineers make a survey, now about completed, for a road from Kaslo City, in the Kootenay mining region, to the junction of Carpenter and Cody Creeks by way of Bear and Fish Lakes. It will be about 30 miles in length. The prospects are now fairly good for its being constructed next summer. The building of the road depends upon the development of the mines. It is reported that there are now about 19 mines shipping ore over the wagon roads to Kootenay Lake.

FLORENCE, CRIPPLE CREEK & STATE LINE.—In a recent interview, Secy. Isaac Canfield, says: "We have a charter for the road, and President Johnson will leave for New York soon to complete arrangements through which the money for constructing the road is to be obtained. The money is practically secured, although there are a few details to be arranged, and it is for this purpose that Mr. Johnson goes East. The proposed road will be 38 miles in length, and in its course will tap the alabaster beds in Fremont County, the gold mines at McCourt, and it is also the intention to run feeders to the principal mines in the Cripple Creek district. There are now 57 shipping mines in the Cripple Creek district, and I look upon it as destined to become the greatest gold producing camp in the United States. It is the intention of the company to put up a 500-stamp mill at the town of Florence for the treatment of Cripple Creek ores."

ELECTRIC RAILWAYS.

NORWICH, CONN.—A franchise is asked for an electric railway to Jewett City and Lisbon.

BROOKLYN, N. Y.—The Brooklyn City Ry. Co. has applied for a franchise covering 50 streets, offering $250,000 for the franchise, while the Kings County Electric Ry. Co., which has applied for a franchise covering some of the streets, made no offer of payment.

NEWARK, N. J.—The South Orange & Newark Ry. Co. has been granted permission to erect poles and wires, and the New Jersey Traction Co. has been permitted to extend its electric system through the city, paying to the city 5% of its gross receipts.

HAGERSTOWN, MD.—A franchise for an electric railway has been granted to W. F. M. McCarty; steel grooved girder rails, 5 ins. high, to be used, with vitrified brick paving between the rails, and 18 ins. on each side.

PHOENIX, ARIZ.—Northern Addition Ry. Co.; $200,000; C. Churchill, F. L. Brill and Geo. W. Hoadley.

ELEVATED RAILWAYS.

BROOKLYN, N. Y.—The decision of the court in the case of the property holders and the proposed elevated railway on Atlantic Ave. has been given in favor of the construction of the railway, which has already been located by the rapid transit commissioners.

HORSE AND MOTOR RAILWAYS.

NEW YORK, N. Y.—The Columbus & Ninth Ave. Ry. Co., $3,000,000, and the Pavonia Ry. Co., $5,000,000, have been incorporated by James J. Traynor, James R. Breen and Howard Van Linderen, to build double track lines 3 and 7 miles long, respectively.

PITTSBURG, PA.—Monterey & Streets Run Ry. Co.; $20,000, with $4,000 paid in; Pres., R. A. Carter.

HIGHWAYS.

NEW JERSEY.—The Union County Board of Freeholders, at Plainfield, has decided to raise by taxes next year 5% of the original cost of the county roads for the purpose of repairs. It is estimated that $15,000 will be needed. The roads were built a few years ago at a cost of over $300,000, and are the best in the state. They comprise the roads from Plainfield to Springfield, thence to Elizabeth, and thence from Plainfield to Elizabeth via Westfield, from Westfield to Rahway, and from Rahway to Elizabeth.

ILLINOIS.—The Macon County Board of Supervisors, at Decatur, has ordered the placing of $80,000 in new court-house bonds to draw 5% until 1912, and recommend that the state offer a bounty for every mile of country roads built in the state.

WATER-WORKS.

New England.

BRATTLEBORO, VT.—L. K. Fuller, B. D. Harris and others have been appointed a committee to employ an engineer and report on village works.

Middle.

ATTLEBORO, MASS.—The purchase of a 1,500,000-gallon pump has been authorized by the voters.

NORTH WOODBURY, CONN.—A water company is proposed.

FALCONER, N. Y.—The village trustees have granted a franchise to A. C. Wade, A. N. Broadhead and others, representing the Falconer Water Supply Co.

LAKEWOOD, N. J.—The town of Busti has granted a franchise to G. N. Cowan, John Hunt and others. Water must not be taken from Lake Chautauqua.

SOUTH AMBOY, N. J.—The Council of Perth Amboy has passed a resolution authorizing the borough to tap

the city water main and pay for water by meter measure.

MAHANOY CITY, PA.—The people have just voted for city works. A company now supplies the city.

Southern.

GRAYTON (NEAR WELCH), W. VA.—A water company has been organized here.

BARNESVILLE, GA.—Bids are wanted by the town for building works, including a supply well at Payne's Spring, a reservoir on Hog Mt., a pumping plant, supply and distributing mains. There will be 24,740 ft. of 8 to 4-in. cast iron, 16 8 to 4-in. valves, 32 3-ft. double nozzle hydrants. Davis, Edwards & Krug, Atlanta, Engineers. Address the Mayor for specifications.

NEWNAN, GA.—It is said that works are wanted.

North Central.

GENEVA, O.—It is said that a Chicago firm wishes to build works and let the city pay for them by installments. C. B. Ensign represents the firm.

CANTON, ILL.—J. C. Thompson, Cy. Clk., informs us that main extensions will be made in the spring and the supply and storage increased.

CHICAGO, ILL.—The Bellewood Water-Works Co. has been incorporated; $10,000; Allen Aldrich, O. V. Carter, W. L. Hitchcock.

ROCKFORD, ILL.—Bids for building a 1,000,000-gallon reservoir, ready for covering, at Rockford, Ill., are wanted until Jan. 9. The bids received Dec. 15 have been rejected. The reservoir will be about 60x150 ft., 20 ft. deep in excavation, with concrete walls and bottom and brick piers. F. G. Hogland, City Clerk; Chas. C. Stowell, City Engineer.

TURNER, ILL.—Mayor Gary recommends that water and sewerage systems be built by the town.

Northwestern.

HARTINGTON, NEB.—The "Democrat" urges that steps be taken to secure works.

Pacific.

COLVILLE, WASH.—Works are again projected.

SATICOY, CAL.—It is said that Los Angeles parties have bought 700 acres of land near by at $50 per acre and will develop water to supply the town.

SUMNER AND BAKERSFIELD, CAL.—It is expected that the Sumner Water Co. will begin work soon. The company has a capital stock of $25,000.

Canada.

SARNIA, ONT.—Improvements are projected; estimated cost, $17,000.

ARTESIAN WELLS.

LOWELL, MASS.—The water board will open bids for driven wells for a new water supply on Jan. 12.

IRRIGATION.

NEW COMPANIES.—Omaha Canal & Power Co., Omaha, Neb.; $3,000,000. Ice House Canyon Water & Power Co., Los Angeles, Cal.; $500,000; directors, J. de Barth Short, L. E. Mosher, and others.

SEWERS.

HARTFORD, CONN.—A meeting was held Dec. 16 to consider the question of a sewerage system, but no action was taken.

SOUTHINGTON, CONN.—We are informed by T. H. McKenzie, Cy. Engr., that surveys and preliminary plans for a system of sewers were prepared by him two years ago, and that it is now proposed to prepare definite plans.

HOOSICK FALLS, N. Y.—Proposals for constructing a system of sewers will be received by the Sewer Commissioners until Feb. 7. Plans and specifications are on file. Joseph Buckley, Pres.; L. C. Wilder, Clk.

WAYNE, PA.—The Darby Creek Sewerage Co. and the Lansdowne Sewerage Co. have united. The scheme proposed is a drainage system for the Darby Creek Valley. The Survey has been completed by Coffin & Altemus, Engrs., as far as Clifton. All the towns and villages between Paoli and Ardmore, along the main line of the Pennsylvania R. R., are included in the survey. From Ardmore the proposed line goes in a southerly direction to Darby Creek.

CLEVELAND, O.—The Director of Public Works will receive bids until Jan. 4 for a timber outlet for the Cuyahoga st. sewer.

TOLEDO, O.—The City Clerk will receive bids until Jan. 9 for constructing a cylindrical brick sewer in Woodville st.

TURNEY, ILL.—The question of a sewer system is being discussed. The mayor has recommended that $500,000 be expended for sewers and water-works.

SIOUX FALLS, S. DAK.—The City Auditor will receive bids until Jan. 5 for several sewers, including an outfall into the Big Sioux River.

EMPORIA, KAN.—The report of the City Engineer regarding sewer extension has been accepted, and the City Council has voted to construct mains in two streets.

BOULDER, COLO.—Plans for a system of sewerage have been prepared by H. J. Reid, Cy. Engr., Colorado Springs. The length of the proposed system is six miles, and the estimated cost $36,000.

GALVESTON, TEX.—The plans of W. Kiersted, Engr. for the Galveston Sewer Co., have been submitted to the City Council. The separate system will be used and the total cost is estimated at $895,347.

OAKLAND, CAL.—Bids will soon be asked for a sewer to cost about $45,000.

STREETS.

BRADFORD, MASS.—A special town meeting is to be held to consider the paving of Main St. The cost is estimated at about $20,000.

JAMESTOWN, N Y.—The Board of Public Works has been looking at paving in Western cities. It is thought probable that they will recommend brick for paving streets in this city. Many streets are so hilly that asphalt could not be used.

WILLIAMSPORT, PA.—The Board of Trade has passed resolutions urging the City Council to begin the work of street paving as soon as possible.

RADFORD, VA.—The Streets Committee will receive bids until Jan. 10 for brick sidewalks and stone curbing. W. J. Smith, Cy. Engr.

HYATTSVILLE, MD.—Surveys are being made for a new boulevard.

JACKSONVILLE, FLA.—The City Council has passed important paving ordinances. It is proposed to issue bonds for $500,000 for municipal improvements.

BELLEVUE, KY.—Brick paving in several streets is being discussed. It is thought that the entire improvement would cost $50,000.

DAYTON, O.—Resolutions have been adopted to pave two streets at a cost of about $110,000 to $150,000, according to material.

STERLING, ILL.—The City Clerk will receive bids until Jan. 16 for 12,812 sq. yds. brick paving, 4,400 lin. ft. curbing and 750 sq. yds. stone retaining wall.

WINONA, MINN.—The City Engineer has been instructed to prepare plans and specifications for paving ten streets with vitrified brick.

CRESTON, IA.—The city will award contracts Jan. 23 for paving three streets, about 18,346 sq. yds., with two courses of brick on 1¼ ins. of sand, sifted sand to be between the courses and the whole covered with 1 in. of fine sharp sand. I. S. Roseberry, Cy. Engr.

ELECTRICAL.

PHILLIPS, ME.—The Phillips Electric Light Co. has voted to contract with C. B. Dalton, Portland, for the installation of a plant. Work will be begun at once, and the lights are expected to be in operation by Jan. 15.

SPRINGFIELD, MASS.—The electric light company offers to furnish the town 20 arc lights at $100 each per year, the company to furnish everything but the lamp arms.

TAUNTON, MASS.—The electric light company has contracted for three additional boilers and a 200-HP. engine, which will give the plant power enough for 5,000 incandescent and 300 arc lights.

FRANKLINVILLE, N. Y.—A committee, consisting of P. T. B. Britton, Dr. J. W. Kales and others, will visit several cities to investigate the different systems of electric lighting.

WELLSVILLE, N. Y.—The Village Board has granted a franchise to the Western Electrical Works for the establishment of an electric light plant. Work will be begun immediately, and it is hoped that the lights may be turned on in January.

TORELEY, MD.—A plant to cost about $20,000 will be put in by F. H. Corthell & Co., Boston, Mass.

HENDERSON, N. C.—W. Thomas has purchased the property of the Henderson Electric Light & Power Co., and it is reported that he will put in an incandescent system.

PARIS, TENN.—The Mayor and Alderman Young have been appointed a committee to correspond with electric companies with regard to the cost of an electric light plant.

SCOTTSBURG, KY.—It is reported that L. Prosser and Julius Steinberg will establish an electric light plant.

NEWCASTLE, IND.—The City Council has voted to purchase and operate an electric light plant.

DUQUOIN, ILL.—The City Clerk will receive bids until Jan. 6 for an electric light franchise.

COLUMBIA, MO.—At a final election Dec. 17 the citizens voted almost unanimously in favor of electric lights, and a franchise has been granted to W. T. Anderson, St. Louis, for water-works and electric light plant. The work will commence at once.

NEW COMPANIES.—Green Island Electric Light Co., Green Island, N. Y.; $25,000; Knight Nefelt, Chas. W. Marsh, Chas. E. Barrett, all of New York. Dillon General Electric Co., Dillon, Mont.; $40,000; E. P. Wetmore, Chas. H. Alexander, Josiah Bowden. Associated Electric Co., of New Jersey, Trenton, N. J.; $20,000; A. R. Kuser, J. W. Hoff, Phillip Frenolen. Havana Electric Co., Havana, Ill.; $30,000; J. W. Bronson, C. C. Travis, May B. Bronson. Electrical Installation Co., Chicago, Ill.; $25,000; L. E. Myers, S. Elansburg, David J. Will.

CONTRACT PRICES.

STREET WORK.—Galveston, Tex.—The following bids were received for paving about 60,000 sq. yds. with creosoted, long leaf, yellow pine blocks, 10 lbs. dead oil per cu. ft.: W. H. Doyle & Co., $2.55 and $2.75 per sq. yd. for 5-in. and 6-in. blocks, respectively; J. W. Byrne & Co., $2 and $2.25, the city to issue certificates for two-thirds of the cost of each block of paving as the work is completed.

PAVING BRICK.—Washington, D. C.—Contracts for paving brick have been awarded as follows: Chas. Ford, 100,000 to 500,000, at $9.50 per M.; Washington Brick & Terra Cotta Co., 50,000 to 200,000, at $10 per M. in the city, $10.17 in the county of Washington, east of the Eastern Branch, and $11 in the county of Washington west of Rock Creek and within one mile of Georgetown; Ivy City Brick Co., 50,000 to 300,000 at $10.50 per M.

STREET SWEEPING.—Indianapolis, Ind.—A contract has been awarded to Isaac F. Reeder for sweeping streets and alleys paved with brick, at 60 cts. per 10,000 sq. ft., and Kentucky Ave., which is paved with asphalt, at 35 cts. per 10,000 sq. ft., the sweeping to be done either daily or tri-weekly.

DITCH.—Napoleon, O.—The County Commissioners have awarded contracts for the Beaver Creek ditch, which, with two small branches, will aggregate 19 miles in length. The maximum breadth is 45 ft., and depth 9 ft. The estimated cost of construction, not including cost of location, is $35,814. The contract for 12.5 miles of the work was awarded to Pollard, Goff & Co., Champaign, Ill., at an average price of 8.5 cts. per cu. yd., the work to be done with dredges. The remaining portion was awarded to mine property owners along the route, at prices averaging 9 cts. per cu. yd.

PIPE AND CASTINGS.—Albany, N. Y.—We are informed by G. I. Baily, Supt. Water-Works, that the following bids were received for 820 tons of pipe and 70,000 lbs. of special castings, the contract for which we noted last week as awarded to R. D. Wood & Co.: R. D. Wood & Co., Philadelphia, Pa., $24.60 per ton for the pipe and 2.4 cts. per lb. for specials; National Foundry & Pipe Works, Scottdale, Pa., $24.90 and 2¼ cts.; Chas. Millar & Son, Utica, $25.76 and 2⅝ cts.; M. J. Drummond, New York, $26.60 and 2⅝ cts. Four informal bids were received, but not considered.

Minneapolis, Minn.—The following bids have been received for about 13 miles, or 5,000 tons, of cast iron water pipe: Denis Long & Co., $24.49 per ton; West Superior Steel & Iron Co., $24.50; Howard-Harrison Iron Co., $25.60; National Foundry & Pipe Works, $24.70 and 2⅝ cts. per lb. for specials; Chattanooga Foundry & Pipe Works, $25.50; McNeal Pipe & Foundry Co., $27.75; Addyston Pipe & Steel Co., $25.40; Lake Shore Foundry, $25.40; Minneapolis Foundry Co., 2 cts. per lb. for specials; Lockwood, Upton & Co., 2½ cts. for specials; George W. Bryant, $32.44 each for hydrants.

MISCELLANEOUS.

BOILERS, ETC.—New York, N. Y.—The Department of Parks will receive bids until Jan. 3 for boilers, water and drainage pipes for the aquarium in the Castle Garden Building, in Battery Park.

PIER.—Wshington, D. C.—The lowest bid received by the Navy Department for the construction of an iron and steel pier at the U. S. coaling station in the harbor of Pago Pago, Samoa, was that of the Coronado Foundry Co., San Diego, Cal., $84,697. There were seven other bids, the highest being $149,500.

DOCKS.—Buffalo, N. Y.—The Department of Public Works will receive bids until Jan. 4 for the construction of a timber dock.

Ashtabula, O.—The Detroit Dry Dock Co. has prepared plans for another large dry dock, and will probably begin construction early in the spring.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Schenectady Locomotive Works, Schenectady, N. Y., have orders for 8 engines for the Chicago & Eastern Illinois, and 3 for the Maine Central. The Roanoke Machine Works, Roanoke, Va., have an order for 5 engines for the Norfolk & Western. The Chicago, St. Paul, Minneapolis & Omaha will place orders for 5 ten-wheel freight engines. The Duluth & Winnipeg will add 10 engines to its equipment. The Louisville, New Albany & Chicago will add extensively to its equipment; Gen. Man., W. H. McDoel.

CARS.—The Barney & Smith Car Co., Dayton, O., has delivered 4 dining cars to the Great Northern. The Haskell & Barker Car Co., Michigan City, Ind., has an order for 200 coal cars, and 50 stock cars for the Louisville, New Albany & Chicago, which road is making extensive additions to its equipment. The Ensign Mfg. Co., Huntington, W. Va., has orders for 750 gondola coal cars and 250 box cars for the Chesapeake & Ohio, all of 60,000 lbs.' capacity, and fitted with air brakes and Janney couplers. The Duluth & Winnipeg will place orders for 500 ore cars, 100 box cars, and 50 flat cars. The Norfolk & Western will add 1,000 freight cars to its equipment.

CAR WORKS.—The Litchfield Car & Machinery Co., Litchfield, Ill., is just completing new machine shops, occupying 12 acres of ground, and having over 95,000 sq. ft. of floor in main buildings. The shops are of brick, 205×55 ft., and are fitted with a 100-HP. Corliss engine and an electric traveling crane of 7½ tons' capacity.

THE BUSH CATTLE GUARD CO., of Kalamazoo, Mich., has recently been awarded the contract for equiping the Michigan Central R. R. from Buffalo to Chicago, single and double track, with its steel cattle guard. About 1,300 guards will be required. The Bush guard has been in use on this road for the past two years. Mr. F. C. Balch, C. E., Manager, informs us that the guard is now in use on 47 railways.

ASPHALT WORKS have been established at Troy, N. Y., by a company consisting of P. H. Feeley, John H. Gleason and P. McKenna. The engineer and architect is J. Schubert, of New York.

THE JOSEPH DIXON CRUCIBLE CO., of Jersey City, N. J., manufacturer of granite pencils, is putting a fifth story, 175×75 ft., on its pencil factory. The company will also establish a rubber and brass plant for the manufacture of the various pencil accessories and novelties.

NEW COMPANIES.—Standard Paving & Construction Co., Newark, N. J.; $100,000; John S. Shaeffer, of Newark; J. S. Smith and DeWitt C. Hanfield, of Brooklyn, N. Y. Queen City Paving Co., Buffalo, N. Y.; $25,000; Thomas J. Rogers, John Druar and A. D. McConnell. Cooley & Vater Co., St. Paul, Minn.; machinery and railway supplies; $50,000; Pres., E. Cooley; Gen. Man., F. F. Vater. Phoenix Pavement Co., Phoenix, Aris.; $20,000; W. C. Master, C. W. Sterns and H. H. Wharton. Railway Supply Co., Chicago, Ill.; $10,000; H. C. Ayer, Robert Roe and T. G. Gedder. Chicago Adamant Wall Plaster Co., Chicago, Ill.; $500,000; Willis Jackson, C. G. Roat and M. S. Holmes. Chicago Street Car Air Brake Co., Chicago, Ill.; $200,000; J. A. Kruse, James Hanley and David Reed. Swedish-American Engineering & Art Co., Jersey City, N. J.; $500,000; gas works, etc.; Carl Guilberg, of Jersey City; G. C. Conrad, of New York, and Magnus Dahlander, of Brooklyn, N. Y.

CURRENT PRICES.

RAILS.—New York: $30 at eastern mills; $30.75 at tidewater; old rails, $17 for iron, and $14.50 and $15 for steel. Pittsburg: $30; old rails, $21 for iron and $15 to $15.50 for steel. Chicago: $31 to $32.50; light rails, $32; old rails, $18.75 for iron, and $12.75 to $15 for steel.

TRACK MATERIAL.—New York: steel angle bars, 1.6 to 1.65 cts.; spikes, 1.9 to 2 cts.; track bolts, 2.4 to 2.6 cts. with square and 2.7 to 2.8 cts. with hexagon nuts. Pittsburg: splice bars, 1.75 to 1.77 cts. for iron and 1.8 cts. for steel; iron and steel spikes, 2.15 cts.; iron track bolts, 2.7 cts. with square and 2.8 cts. with hexagon nuts. Chicago: splice bars, 1.65 to 1.75 cts. for iron and steel; spikes, 2.05 to 2.1 cts. at mill; track bolts, 2.6 to 2.7 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows at Pittsburg: 55% and 10%, and 47½% and 10% on black and galvanized butt welded; 65% and 10%, and 55% and 10% on black and galvanized lap welded. Casing, 57½%.

FOUNDRY PIG IRON.—New York: $13.25 to $15. Pittsburg: $13 to $14. Chicago: $13.25 to $14.25.

LEAD.—New York: 3.8 to 3.85 cts.; Chicago: 3.55 cts.; St. Louis: 3.5 cts.

STRUCTURAL MATERIAL.—New York: beams, 2 to 2.25 cts. for large lots, and 2.25 to 2.75 cts. for small lots; channels, 2.1 to 2.2 cts.; angles, 1.85 to 2 cts.; tees, 2.1 to 2.3 cts.; sheared iron plates, 1.85 to 2.1 cts.; steel plates, 1.85 to 2 cts. for tank, 2.2 to 2.25 cts. for shell, 2.4 to 2.65 cts. for flange, 2.6 to 2.8 cts. for firebox. Pittsburg: beams, 2 to 2.25 cts.; channels, 2 to 2.25 cts.; angles, 1.75 to 1.9 cts.; tees, 2.1 to 2.2 cts.; Z bars, 1.9 cts.; universal mill plates, 1.7 to 1.8 cts.; sheared steel bridge plates, 2.1 to 2.25 cts.; refined bars, 1.7 cts. for iron and steel; steel plates, 1.65 to 1.7 cts.; tank, 1.95 to 2.05 cts. for shell, 2 cts. for flange, 3.4 to 3.45 cts. for firebox, 1.9 to 2 cts. for bridge. Chicago: beams, 2.25 to 2.3 cts. for large lots, and 2.35 to 2.5 cts. for small lots; channels, 2.27 to 2.35 cts. for large lots, and 2.45 to 2.5 for small lots; angles, 1.9 to 2 cts.; tees, 2.2 to 2.3 cts.; universal plates, 1.95 to 2.1 cts.; steel plates (at mill), 2 to 2.1 cts. for tank, 2.12 to 2.25 cts. for shell, 2.25 to 2.75 cts. for flange, 2.7 to 2.8 cts. for firebox.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Volume XXVIII
No. 53.

$5.00 per year.
Single Copies 15 Cents.

NEW YORK, THURSDAY, DECEMBER 29, 1892.

C. E. LOSS & CO.,
Electrical, Steam and Surface Railway Contractors.
MUNICIPAL, CANAL AND MASONRY WORK.
621 PULLMAN BLDG., CHICAGO.

GEO. A. EVANS,
Steel Rails & Equipment
18 WALL ST., NEW YORK.

FLUSH TANK CO.,
189 La Salle Street, Chicago, Ill.
Send for our **grand new illustrated catalogue. Automatic siphons for flushing** sewers, closets and urinals. **No movable parts.** Over 6,000 in use in the United States and in Canada. Patents of Williams, Waring, Field and others.

PULSOMETER STEAM PUMP.
SEE ADV. PAGE XXXIII.

H. B. PAINE, Ex-Com. of Patents. S. B. LADD.
PATENTS and PATENT CAUSES.
PAINE & LADD,
ATTORNEYS AT LAW, - WASHINGTON, D. C.
LOAN & TRUST BUILDING.

PARK FIRE CLAY CO.,
MANUFACTURERS OF
VITRIFIED PAVING BRICK
WRITE US FOR PRICES.
PARK QUARRIES, Beaver Co., Pa.
Room 7, 55 Ninth St., Pittsburg, Pa.

BRADFORD L. GILBERT, ARCHITECT,
Tower Building, New York
Auditorium Tower, Chicago
Ames Building, Boston
SPECIALTY: RAILROAD STATIONS

The Double Girder Lap Joint
STREET RAILWAY TRACK
IS THE BEST.
Duplex Street Railway Track Co.,
NO. 51 WALL ST., NEW YORK.

THE UNION SWITCH & SIGNAL CO.
Geo. Westinghouse, Jr., President.
E. H. Goodman, Vice-Pres. and Gen'l Mgr. | Jas. Johnson, Sec'y and Treas.
J. G. Schreuder, Chief Engineer. | Geo. H. Paine, Gen'l Agt.
General Office and Works: SWISSVALE, Allegheny County, Penna., U. S. A. Designers and Manfrs. of **Interlocking and Block Signal Appliances, Frogs, Slips, Switches, Switch Stands,** Etc. Sole manufacturers of the **Westinghouse Pat. Pneumatic Interlocking and Automatic Block Signal** Systems; Electric Automatic Track Circuit Block Signals; Electric Locking; Sykes System; Electric Crossing Alarm Bells; Saxby & Farmer Improved Interlocking; Special Appliances for protection of Draw Bridges, etc., etc. Plans and Estimates Furnished on Application.
BOSTON OFFICE: Hathaway Bldg. | NEW YORK OFFICE: Times Bldg. | CHICAGO OFFICE: Building.

Wm. P. Hall, President. W. S. Gilmore, Treasurer. S. Marsh Young, Vice-President.
THE HALL SIGNAL CO.,
50 Broadway, New York. 927 The Rookery, Chicago.
The Hall System of Automatic Electric Signals is in operation and process of erection on TWENTY-FIVE ROADS.
We have recently acquired and are now prepared to furnish
THE BEEBE LOCK AND BLOCK SYSTEM,
THE BEEBE AND BURLEY INTERLOCKING MACHINE,
besides all the latest and best improvements in MECHANICAL SIGNALING

LIGHT CARS -OF ALL KINDS- FOR MINING, LOGGING, PLANTATION CONTRACTORS & RAILWAY USE.
SHEFFIELD VELOCIPEDE CAR CO
25 OAK STREET, THREE RIVERS, MICH.

BLACKMER & POST PIPE CO.,
MANUFACTURERS OF
STANDARD SEWER PIPE
— AND —
Double Strength Culvert Pipe,
Exclusively in 2½ Foot Lengths with Improved Sockets.
Branch Office: ST. PAUL, MINN. Gen'l Office and Factories: ST. LOUIS, MO.
Send for Pamphlet, "SOMETHING ABOUT CULVERT PIPE."

W. L. STEBBINGS,
Civil and Consulting Engineer,
1118 Monadnock Bldg., CHICAGO.
Bridges and Buildings.

J. C. SLOCUM, D. E.,
Consul ing Mechanical Engineer.
Smokeless Economical Combustion. Plans, Specifications, Tests, Examinations, Estimates, Superintendence.
235 La Salle St., Chicago.

NATIONAL
NATIONAL SWITCH & SIGNAL CO.
New York Office, 41 Pine Street.
London Office, 70 & 71 Palace Chambers, Westminster, S. W.
Office and Works, Easton, Pa.
Western Union Telegraph and Long Distance Telephone Connections.

R. Carman Combes, President,
O. F. Reinhard, Sec'y and Treas.
Thomas J. Swift, Managing Director.
H. S. Pfeil, Gen. Agt. and Signal Engr.
John P. O'Donnell, Consulting Engr.
Designers and Manufacturers of
RAILROAD SAFETY APPLIANCES.
Mechanical and Electrical Interlocking; Mechanical, Electrical and Manual Block Signals; Distance Switch Signals; Koyl's Parabolic Illuminated Semaphore; National Repeating Torpedo Signal; M. & S. Double Wire Compensator; National Selector; Adjustable Clamp Pipe Lug, etc.
Plans Made and Bids Submitted for Interlocking Terminals, Yards, Junctions, Grade Crossings, Draw Bridges, Passing Stations, etc.

JUST ISSUED. CATALOGUE No. 7
CLAYTON AIR COMPRESSORS
For All Purposes and Pressures.
Mailed FREE on Application.
CLAYTON AIR COMPRESSOR WORKS
43 Dey Street, New York.

STANDARD STEEL CASTING CO.—OPEN HEARTH STEEL CASTINGS—THURLOW, PA.

C. R. JOHNSON, Pres. & Gen'l Mgr. WM. P. HALL, V.-Pres. & Mng. Dir. H. JOHNSON, Asst. Gen. Mgr. & Treas. D. W. PHELAN, Secretary. H. M. SPERRY, Gen'l Agent.
THE JOHNSON RAILROAD SIGNAL CO.,
DESIGNERS AND MANUFACTURERS OF
Interlocking and Block Signaling Appliances.
Plans and bids submitted for interlocking *Grade Crossings, Drawbridges, Junctions, Yards, Terminals, Passing Stations, etc.*
SOLE OWNERS AND MANUFACTURERS OF THE
SYKES BLOCK SIGNAL SYSTEM.
GENERAL OFFICE AND WORKS, RAHWAY, N. J.
NEW YORK OFFICE, 47 Broadway. CHICAGO OFFICE, The Rookery. BOSTON OFFICE, Ames Building.

SAFETY VALVES
THE ASHTON VALVE CO, - - - Boston, New York, Chicago.
STEAM GAGES

PENNSYLVANIA STEEL COMPANY'S
Advertisement on page 8, and 27,
Should be seen by all persons engaged or interested in
RAILROAD MATTERS.

Electrical and Mining Engineer.
ALFRED GUILLAUME,
915 Dearborn St., Chicago.
Inquire about Guillaume's Dryer.
Western Ag't of the Williams Engine of Baltimore Md.

PATENTS HOPKINS & ATKINS, Patent Lawyers,
ATLANTIC BUILDING, 930 F ST., WASHINGTON, D. C.
Members of the Bar of the Supreme Court of the United States.

Engineering Magazine
FOR CONTENTS OF THE DECEMBER NUMBER SEE PAGE XII.

11 Original and Controlling Patents for Sloping Metal Slats allowed and issued.
STANDARD CATTLE GUARDS
LARGELY PURCHASED BY OVER 30 RAILROADS THE FIRST YEAR.
Write for New Catalogue of 6 Styles, Address 39-41 W. Washington St., Chicago, Ill.

ENGINEER'S DIRECTORY.

ALEXANDER, HILL & DUNLAP, *Civil Engineers,*
CHAMBER OF COMMERCE BUILDING, SUITE 905, CHICAGO.
Sewerage, Water Supply, Paving, Bridges, Railway Surveys, Investigations and Reports. Specifications, Plans, Estimates and Construction Superintended.

SAMUEL A. ARTINGSTALL, 28 Rialto Building, Chicago,
Civil Engineer.
Plans, Specifications and Estimates for Water-Works, Sewerage, Bridges and Municipal Work.

WM. A. AYCRIGG, 32 Warren and 102 Chambers Streets, N. Y.
Civil Engineer.
Designs and estimates for bridges and roofs. Inspection of structural iron and steel. Railroad Engineering. Surveys.

STEPHEN E. BABCOCK, *Consulting Engineer,*
Water-Works and Sewerage. LITTLE FALLS, N. Y.

WILLIAM S. BACOT, C. E., Mem. Am. Soc. C. E., *Engineer of County Roads.*
RICHMOND CO., Staten Island, N. Y. SPECIALTIES: Water-Works, Sewerage, Improvements of Roads.
OFFICES: 145 BROADWAY, NEW YORK, and STAPLETON, S. I.

EDW. BARRATH & CO., *"Monadnock" Block, Room 1404, Chicago, Ill.*
Architects, Mechanical Engineers.
DRAFTING AND ENGINEERING OFFICE.
Packing Houses and Manufacturing Plants a Specialty. All Kinds of Iron and Steel Structures and Special Machinery Designed. Blueprinting and Drafting in General.

BASSETT BROS., 298 Main St., Buffalo, N. Y.,
Engineers and Contractors.
Water-Works, Water Supply, and Sewers.

BERTHOUD & MOSES, Haseltine Building, Philadelphia, Penna.
CIVIL AND MECHANICAL ENGINEERS.
BRIDGES, CRANES, WATER-WORKS, ROLLING MACHINERY AND FURNACES.

EDWARD M. BOGGS, *Civil and Hydraulic Engineer,* TUCSON, ARIZ.
Irrigation, Water Development and Storage. University of Arizona.

G. BOUSCAREN, Mitchell Building, Cincinnati, O.,
Consulting Engineer.
Surveys, Construction and Inspection of Railways, Long-Span Bridges and Roofs. Structural Works of Iron and Steel, Water-Works, Irrigation, Drainage and Sewerage Systems.

THOMAS C. CLARKE, 44 Broadway, New York,
Consulting Engineer.
Cable Address: Meliate.

COOKE & READ, 220 Soc. for Savings Bldg., Cleveland, O.
E. C. COOKE, C. E. *Engineers & Contractors.* W. W. READ, C. E.
Plans, estimates and specifications prepared for water-works, sewerage, railways and municipal work. Contracts taken and work superintended.

J. A. COLBY, Girard Building, Philadelphia, Pa.,
Inspection of Materials and Workmanship for Bridges and Buildings.

JOHN A. COLE, *Consulting Engineer,* Rooms 30, 31, 55 Dearborn St., Chicago.
Water-Works, Street Railways and Sewerage.

WM. W. CREHORE, *Civil Engineer,* 25 Pine St., New York City.
Designs and Computations for Bridges, Roofs, Girders, Turn-tables, Structural Iron Work, etc., etc. Inspection and Superintendence of Erection.

JAS. J. R. CROES, M.Am.Soc.C.E.; M.Inst.C.E., 13 William St., N. Y. City,
Consulting Engineer.
Examinations and Reports Made on Projects for Water Supply and Sewerage of Towns, Rapid Transit and River Improvements. Plans and Specifications Prepared and Work of Construction Superintended.

LEE L. DAGRON, *Civil and Inspecting Engineer,* 447 Rookery, Chicago, Ill.
Specialties: Inspection, Construction and Erection of Bridges, Buildings, Cars, etc.

CHESTER B. DAVIS, M.Am.Soc.C.E., 1627 Monadnock Bldg. Chicago, Ill.
Consulting Civil Engineer.
SPECIALTIES: Hydraulic and Sanitary Work. Plans, Specifications and Estimates Prepared, and Work Superintended. Correspondence invited.

T. DENGLER, E. M., 512 Webster Ave., Chicago,
Mining Engineer and Chemist.

P. P. DICKINSON, M. Am. Soc. C. E., No. 7 Nassau St., New York,
Consulting Engineer and Contractor.
Railroads surveyed and estimates of cost furnished. Contracts entered into for the construction of Railroads, Canals, Water-Works, Sewerage, etc. Mineral Lands surveyed and reported upon.

THOMAS M. DROWN, *Mass. Institute of Technology,* Boston, Mass.
Advice with regard to Water Supply and Sewage Disposal, particularly from a sanitary standpoint.

F. A. DUNHAM, Engineer of Union County (N. J.) Road System, *Civil Engineer.*
NO. 7 PARK AVENUE, PLAINFIELD, N. J.
Special attention given to the Paving and Improvement of Streets and Roads. Plans, Estimates and Specifications for Engineering Works Furnished and Construction Superintended.

DUNHAM & PAINE,
Civil and Consulting Engineers,
No. 150 BROADWAY, NEW YORK, and CITY HALL BLDG., CLEVELAND, O.

T. C. EGGLESTON, M. Am. Soc. C. E. W. F. DENNIS, M. Am. Soc. C. E.
EGGLESTON & DENNIS, P.O. Box 186, Shafer Bldg., Richmond, Va.
Civil Engineers.

E. D. ESTRADA. E. H. KENYON. J. H. GRAY.
ESTRADA, KENYON & GRAY, *Engineer Inspectors of Iron and Steel,*
307 Lewis Block, PITTSBURG, PA. 516 Ashland Block, CHICAGO.

G. W. G. FERRIS & CO., *Civil Engineers,*
Inspectors of Structural Iron and Steel. PITTSBURG, PA.

WILLIAM P. FIELD, Prudential Bldg. Broad cor. Bank St., Newark, N. J.,
Civil Engineer.
Foundations, Roofs, Buildings, Bridges, Railways and Railway Structures.

BERNHARD FEIND, M. Am. Soc. C. E. *Civil and Hydraulic Engineer,*
1105-7 THE ROOKERY, CHICAGO, ILL.
Surveys, Designs, Estimates and Supervision of Construction for Water-Works, Water Power and Hydraulic Pressure Plants, Sewerage and River and Harbor Works.

FRANK L. FULLER, M. Am. Soc. C. E., *Civil and Hydraulic Engineer,*
ROOMS 35, 36, 12 PEARL ST., BOSTON, MASS.
Special attention given to Water Supply and Drainage.

WOLCOTT C. FOSTER, *Civil Engineer,* 52 BROADWAY, NEW YORK.

PITTSBURGH TESTING LABORATORY.

HUNT & CLAPP, 116 Water St., Pittsburgh, Pa.,
Metallurgical Engineers and Chemists.
SPECIALTIES: Inspection of Rails and of Materials for Bridges and other structures. Steam Boilers, Locomotives, Cars, etc. Inspection of Shop Work and Erection at Bridge Site. Chemical Analyses and Physical Tests of all kinds.
Agents for Tinius Olsen & Co.'s Testing Machines; Thacher's Slide Rules.

SAMUEL WILSON FRESCOLN, C. E., M. S., *Engineer and Contractor,*
WORLD BUILDING, NEW YORK. See page xxviii. for advertisement.

EDWARD FLAD, 118 Laclede Building, St. Louis, Mo.
Civil and Mechanical Engineer.

JOS. P. FRIZELL, 60 Congress St., Boston, Mass.
Hydraulic Engineer.
Development, Transmission, Distribution and Application of Water Power.

SAMUEL M. GRAY, 20 Market St., Providence, R. I.,
Consulting Engineer for Municipal and Sanitary Work.

JO. C. GUILD. LINN WHITE.
OFFICE AND LABORATORY: 20, 21 AND 22 KEYSTONE BLOCK.
GUILD & WHITE, Chattanooga, Tenn.
Engineers and Chemists.

ROBERT L. HARRIS, M. Am. Soc. C. E.; M. Inst. C. E. *1 Broadway, New York, N. Y.*
Consulting Civil Engineer—Railways.
Examinations, Reports, etc., Made. New Method of Dealing with QUICKSAND, etc. See "Engineering News" of April 28, 1892, pp. 420.). Conduits, etc., for Electric Railways (See "Street Railway News," Oct. 24, 1891).

ALLEN HAZEN, *Chemist,* Lawrence, Mass.,
Sanitary Water Analysis. Mechanical Analysis of Materials Proposed for the Filtration of Sewage.

RUDOLPH HERING, M. Am. Soc. C. E., M. Inst. C. E., M. Can. Soc. C. E.,
Civil and Sanitary Engineer,
277 PEARL STREET, NEAR FULTON, NEW YORK.
Designs for Water Supply and Sewerage. Construction Superintended.

JOHN W. HILL, M. Am. Soc. C. E., 35 & 36 Glenn Bldg., Cincinnati, O.
Consulting and Constructing Engineer.
For Water-Works, Sewerage, &c.

R. W. HILDRETH & CO., *Inspecting Engineers,*
2 Wall St., New York; Philadelphia and Pittsburg, Pa.
L. L. DAGRON, Western Representative, 447 The Rookery, Chicago, Ill.
Inspection of Railway Equipment, Bridges, Rails and Rolling Stock.

D. J. HOWELL, National Union Bldg., Washington, D. C.,
Civil Engineer and Landscape Architect.

W. B. W. HOWE, Jr., *Consulting Engineer,* Knoxville, Tenn.
Late Chief Engineer Plant System of Railways, Surveys, Construction and Inspection of Railways Foundations, Bridges, Water-Works, Sewerage and General Engineering.

THE ROBERT W. HUNT CO.,
Bureau of Inspection, Tests and Consultation.
GENERAL OFFICE: "The Rookery," Chicago. BRANCH OFFICES: Hamilton Bldg., Pittsburg; Union Trust Co. Bldg., New York City; 328 Chestnut St., Philadelphia.

WM. R. HUTTON, 35 Broadway, New York City,
Consulting Engineer.
Water-Works and Water-Powers, River and Harbor Works, Railways.

D. C. JACKSON, C. E., Madison, Wis., M. Am. Soc. M. E., Am. Inst. E. E.
UNIVERSITY OF WISCONSIN.
Consulting Electrical Engineer.
Plans, Supervision and Tests of Electrical Railway, Mining, Power and Light Plants.

JULIAN KENNEDY, Vandergrift Building, Pittsburg, Pa.
Consulting and Contracting Engineer.
Blast Furnaces, Bessemer and Open-Hearth Steel Works, Steam and Hydraulic Machinery, Gas Producers, etc.

OLIN H. LANDRETH, Nashville, Tenn., M. AM. SOC. C. E. M. AM. SOC. M. E.
Engineering Department, Vanderbilt University.
Consulting Engineer.
Water-Works, Water Power, Drainage, Reclamation, Improvement of Highways and Street Paving, Examinations, Expert Tests, Reports, Designs, Specifications and Estimates.

W. B. LAWSON, *Civil and Consulting Engineer, 504 McPhee Block, DENVER, COLO.*
Problems in Location and Construction of Railroads and Transit Lines a Specialty. Plans, Specifications and Superintendence of Works. Investigations and Reports.

KARL L. LEHMANN, *Civil Engineer and Architect, 67 Portland Block, CHICAGO.*
SPECIALTIES: Calculation and Designing of Buildings and Bridges, Stone Arches and Foundations.

HARRY J. LEWIS, *Civil Engineer,* STATION B, PITTSBURGH, PA.

A. W. and F. B. LOCKE, *Engineers,* 53 STATE ST., BOSTON.
Railroads, Tunnels and Sanitary Work. Plans and Superintendence of Construction. Examinations of Railroad and Mining Property. Preparatory work undertaken to show the merits and demerits of new enterprises, their feasibility and sources of revenue.

CHAS. F. LOWETH, Mem. Am. Soc., C. E., Mem. Am. Water-Works Assoc.,
Consulting Civil Engineer,
560 AND 561 DRAKE BLOCK, ST. PAUL, MINN.
Plans, Specifications, Estimates and Supervision of Water-Works, Sewerage, Bridges and Municipal Works.

ALBERT LUCIUS, *Civil and Mechanical Engineer,* 71 BROADWAY, N. Y.
All kinds of Engineering Structures, Plans, Specifications, Estimates, Superintendence, Bridge Inspection and Reports.

JOHN MAC LEOD, M.Am.Soc.C.E., Ky. Nat'l Bank Bldg., Louisville, Ky.,
Consulting Engineer.
Surveys and Construction of Railroads, Bridges, Deep Foundations and Other Engineering Works. Plans, Specifications and Estimates Furnished and Construction Superintended. Examinations and Reports Made of Railroad Properties, Projected Lines, Mineral and Timber Lands. Consultation invited.

WILLIAM P. MASON, Rensselaer Polytechnic Institute, Troy, N. Y.,
Water Analysis.
Examination of and reports upon proposed sources of water supply.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.

SCHOOL OF ENGINEERING. ESTABLISHED 1826. SEND FOR A CATALOGUE TO THE DIRECTOR.

PENNSYLVANIA MILITARY ACADEMY, CHESTER, PA.

A MILITARY COLLEGE. Degrees in Civil Engineering, Chemistry, Arts. COL. C. E. HYATT, Pres.

UNIVERSITY OF ILLINOIS, CHAMPAIGN, ILL.

Courses in CIVIL, MECHANICAL, ELECTRICAL and MINING ENGINEERING, and in ARCHITECTURE. Also seven courses in literature and science. Forty-two instructors; extensive equipment; fees merely nominal. For catalogue or information address REGENT, Champaign, Ill.

SIBLEY COLLEGE, CORNELL UNIVERSITY, ITHACA, N. Y.,

Is prepared to make tests of iron and steel on various machines up to 300,000 lbs. capacity. Test trials of engines, boilers and other machinery, and all kinds of experimental investigation engineering work. R. H. THURSTON, Director. R. C. CARPENTER, Superintendent Laboratory.

WESTERN UNIVERSITY OF PENNSYLVANIA, ALLEGHENY, PA.

Engineering Department. Courses in Civil, Mechanical and Electrical Engineering. Shops and Laboratories. For information address DANIEL CARHART, Dean.

RALPH MODJESKI, 218 La Salle St., Chicago.
Civil Engineer.

Designing, Inspecting, and Building of Long and Short Span Bridges, Viaducts and Other Metallic Structures: Inspection of Material at the Mills and Shops.

A. LEOFRED (GRADUATE OF LAVAL AND MCGILL),
MINING ENGINEER.
Head Office: QUEBEC. Branch Office: MONTREAL.

JOS. O. OSGOOD, M. Am. Soc. C. E. **120 Broadway, New York.**
Consulting Engineer.

Makes Specialty of Reports on Railroads and Other Investment Properties. Examinations Made in Any Part of the Country.

ALFRED D. OTTEWELL,
Engineer for Bridges and Buildings,
14 SANSOME STREET, SAN FRANCISCO, CAL.

WM. BARCLAY PARSONS, M. Am. Soc. C. E., *Civil Engineer,*
22 WILLIAM ST., NEW YORK.

M. S. PARKER, M. Am. Soc. C. E., **Great Falls, Mont.**
Economic Location of Railways. Plans, Specifications and Estimates on Municipal Works. Bridges Designed and Superintended. Foundations. Correspondence Solicited.

M. P. PARET, M. Am. Soc. C. E., **210 E. Lexington St., Baltimore, Md.**
LEHIGH GRADUATE, 1878.
SPECIALTIES: Hydrographic Surveys and Investigations, Gagings, etc. Railroad Surveys, Preliminary and Location, with Reports.

Work done under contract and specifications, thus insuring economy and accuracy, and saving time.
About 8 years U. S. Ass't Engr. in charge of various works along Atlantic Coast.
Six years with Penna. R. R. on heavy construction.

C. O. PARKER, M. Am. Soc. C. E., *Civil Engineer,* **33 Keystone Block, Chattanooga, Tenn.**
Railway Reconnaissance, Survey and Construction. Mining and Topographical Work, Surveys and Plats of Town or Suburban Property. Water Supply, Drainage, Sewers, Masonry, Highways. Dams for Lakes or Reservoirs. Estimates, Plans, Superintendence. ☞ Expert Reports on Railway and Mining Properties.

HIRAM PHILLIPS, *Consulting Engineer,*
810 OLIVE ST., ST. LOUIS, MO.
Expert Tests and Reports of All Kinds of Materials Used for Structural Work, Examinations, Plans, Specifications and Estimates.

JOSEPH C. PLATT, *Consulting Engineer,* **Waterford, N. Y.**
Investigations and Reports. Engineering and Manufacturing.

ALEXANDER POTTER, C. E. (Lehigh), Assoc. M. Am. Soc. C. E.,
Civil and Sanitary Engineer,
CITY HALL, OLEAN, N. Y.
Surveys, plans, specifications and estimates for water supply and sewerage of towns, paving and street work. Construction superintended. Correspondence invited.

WM. G. RAYMOND, Troy, New York.
Consulting Civil Engineer.
Railroad Location, Structures, Surveys, Examinations and Reports.

C. REMINGTON. **REMINGTON & CO.,** *Chicago, Ill.,* F. REMINGTON.
Correspondence Solicited. *General Contractors.* Office: Suite 1100, Title and Trust Building.
Railroads, Water-Works, Sewerage, Masonry, Macadamizing, Excavating, Grading and Filling. Municipal Improvements of every description.

WALTER P. RICE, M. Am. Soc. C. E., **Room 454 Arcade, Cleveland, O.**
Civil and Consulting Engineer.
Consultations, Reports, Estimates, Specifications and Plans for Bridges and Other Structures, Sewerage, Harbor Work and Shore Protection, Electric Railways, Etc.

PALMER C. RICKETTS, *Consulting Engineer,* **17 FIRST ST., TROY, N. Y.**
Bridges, Roofs, etc. Plans, Specifications, Estimates, Superintendence, Inspection and Reports.

GEO. S. RICE and GEO. E. EVANS, Members A. S. of C. E.
Civil and Hydraulic Engineers, 95 Milk St., Boston, Mass.
Water Supply, Sewerage, Drainage and all classes of Municipal Work.

RICKER & WING, Offices 111 & 112 White Building, Buffalo, N. Y.
GEO. A. RICKER. *Civil and Landscape Engineers.* FRED'K K. WING.
Railroad Surveys, Landscape Engineering, Building Plans, Specifications and Superintendence.

H. C. RIPLEY, Galveston, Tex., *Civil Engineer,*
Chief Engineer of Ropes Pass Improvement. (Late U. S. Assistant Engineer in charge of Galveston Harbor Improvement). Twenty years' experience on the Lakes and Gulf Coast in connection with the improvement of Rivers and Harbors. Specialties: Hydrographic Surveying, Plans, Estimates and Specifications for Harbor Improvements, and Other Marine Works.

JOHN A. ROEBLING, C. E., Morris Plains, N. J.
SUSPENSION BRIDGES.

S. B. ROBBINS, Great Falls, Mont., *Civil and Mining Engineer.*
RAILWAYS—IRRIGATION—MINING.

Professor Drawing, Philadelphia Manual Training School. Secretary Engineers Club, Philadelphia. Secretary and Treasurer Electrical Section Franklin Institute.

L. F. RONDINELLA, M. E., 705 Chestnut St., Philadelphia, Pa.
Mechanical, Electrical and Civil Engineer.

ANDREW ROSEWATER, M. Am. Soc. C. E., **424 Bee Bldg, Omaha, Neb.**
Engineer Municipal Public Works. Sewerage a Specialty.

S. M. ROWE, Mem. Am. Soc. C. E. R. D. ROWE, Mem. Am. Soc. C. E.
ROWE & ROWE, 330 Webster Ave., Chicago, Ill.,
Superintending and Consulting Engineers,
Surveys Plans, Estimates, Superintendence and Inspection of Railroad, Hydraulic, Bridge and General Engineering Work.

Mem. Am. Soc. Civil Engineers. Mem. Am. Inst. Mining Engineers. Asso. Am. Inst. Elec. Eng'rs
FREDERICK H. SMITH, 227 E. German St., Baltimore, Md.,
Consulting Engineer and Geologist, Bridge Engineer.

FRANK SNYDER, 113 N. Fourth St., Columbus, O.,
Hydraulic and Sanitary Engineer.
Designs and Estimates for Sewerage, Sewage Disposal and Water Supply. Construction Superintende

OSCAR SANNE, *Consulting Bridge Engineer,*
Room 60, COLBY & ABBOT BUILDING, MILWAUKEE.
Estimates, Specifications, Details of Steel and Iron Construction.

F. G. & G. R. SIKES, *Civil Engineers,*
81 & 82 WHITE BLDG., BUFFALO, N. Y. Branch Office: TONAWANDA, N. Y.
Bridges, Railway Projects, Surveys, Plans, Specifications, Construction Superintended.

JESSE M. SMITH, M. Am. Soc. Mech. Eng., M. Am. Inst. Elec. Eng.,
Mechanical and Electrical Engineer.
EXPERT IN PATENT CAUSES. 36 MOFFAT BLOCK, DETROIT, MICH

ISAAC A. SMITH, M. AM. SOC. C. E., *Architect and Civil Engineer,*
ROOM 604, THE ORIEL Sixth and Locust ST. LOUIS, MO.
General Engineering and Architecture. Surveys, Building Plans and Specifications. Water-Works, Electric Light and Sanitary Drainage. Legal Engineering Evidence. Reports on Bonded properties.

EDWARD S. SHAW, 146 Franklin St., Boston, Mass., Bridge and Consulting Engineer. Bridges and Other Structural Work, Designs and Specifications, Examinations and Reports, Supervision of Construction

VANCE & MEDDIS, 223 Fourth Avenue, Louisville, Ky.
Civil Engineers and Surveyors.

CHARLES W. KNIGHT. CHAS. C. HOPKINS, M. Am. Soc. C. E. JAMES W. KITTRELL, Civil Engineers
THE STANWIX ENGINEERING CO., Rome, N. Y.,
Sanitary and Hydraulic Engineering a Specialty.
Designs, Specifications, Estimates and Reports for Water-Works and Sewerage. Construction Superintended. Correspondence Solicited.

JAS. T. TAYLOR, *Civil and Hydraulic Engineer,*
MORENO, PERRIS, ALESSANDRO.
Address: P. O. Alessandro, San Bernardino Co., Cal.
Plans, Estimates and Reports. Irrigation and Water Supply. Works and Structures.

J. C. TEMPLE, Dayton, Ohio, *Hydraulic and Mechanical Engineer.*
Designs and Estimates for Water-Power Improvements, Water-Works, Water and Steam Power Plants
HART VANCE, M. Am. Soc. C. E. E. H. MEDDIS.

M. TSCHIRGI, JR., *Civil and Sanitary Engineer,* **Dubuque, Ia.**
Plans and Estimates Furnished for Sewerage, Water-Works, Bridges Etc.

C. C. VERMEULE, *Civil and Topographical Engineer,*
ROOM 133, 71 BROADWAY, NEW YORK.

VON SCHON & GARNER, Fredericksburg, Va., *Civil Engineers.*
Reports on Railroad, Timber, Mineral and Town Site Surveys. Sewerage and Water-Works. Railroad Topographical and Land Surveys. We Operate Throughout the South.

J. A. L. WADDELL, *Consulting Bridge Engineer,*
Keith and Perry Building., Kansas City, Mo.
Branch Office, Room 945 The Rookery, Chicago, Ill.
Superstructure, Substructure, Borings, Train-Sheds. Designs, Estimates and Superintendence. Expert Examination of Old Structures.

G. E. WARING, Jr., M. Inst. C. E. W. H. CHAPMAN. F. W. FARQUHAR
WARING, CHAPMAN & FARQUHAR, *Civil Engineers,*
NEWPORT, R. I. and 874 BROADWAY, N. Y
Furnish Plans for and Supervise the Construction of Sewerage, Drainage, Plumbing, Water-Works, etc Topographical Work and the Laying Out of Towns. GEO. E. WARING, JR., Consulting Engineer.

GEO. E. WARING, Jr., M. Inst. C. E., *Consulting Engineer,*
NEWPORT, R. I. and 874 BROADWAY, N. Y.
Sanitary and Agricultural Drainage, the Laying Out of Towns.

WILLIAM J. WILGUS, *Civil Engineer,* **601-602 Endicott Bldg., St. Paul, Minn.**
Designs, Surveys and Estimates for Railway Terminals, Depots, Etc. Location and Construction Steam and Electric Railways. Power Plants. Lawsuit Testimony. Townsites. Sewerage, Drainage and Waterworks. CONSTRUCTION SUPERINTENDED.

WM. GLYDE WILKINS, C. E., M. Am. Soc. C. E. GEO. S. DAVISON, C. E., M. AM. SOC. C. E.
WILKINS & DAVISON, Westinghouse Bldg., Pittsburg, Pa.,
Surveys, Plans and Estimates made for Railroads, Water-Works, Bridges and Sewerage. Special attention given to Coke Plants, Foundations, Buildings, and Railroad Tracks for Blast Furnaces and Manufacturing Establishments.

WM. HENRY WHITE, *Engineer and Contractor,* **32 PINE ST., NEW YORK.**
Water and Gas Works a Specialty.

WILSON BROS. & CO., Drexel Bldg., Philadelphia, Pa.,
Civil Engineers and Architects.
Surveys Made for Railway Lines. Plans and Specifications Furnished for Buildings, Bridges, Water-Works, Sewerage Systems, Harbor Improvements, and all Classes of Engineering and Architectural Work. Construction of Work attended to. Examinations Made of Railway, Mining and Other Properties.

WISE & WATSON, *Civil and Sanitary Engineers.* COLIN R. WISE.

R. H. YEATS. Chicago Representatives, THE WEIR FROG CO., Cincinnati, O. CHAS. GIBSON.
YEATS & GIBSON, 80 La Salle Street, Room 3, Chicago,
Civil Engineers.
Complicated Railroad Track Work a Specialty.

ESTABLISHED 1883. Former address, 60 Spring St., N. Y.
DONATO CUOZZO, General Contractor, 386 Broome St., N. Y.
Italian Labor Employment and Supply Agency
for the construction of Railroads, Water-Works, Sewerage, Stone Cutting, Stone Masonry, etc. Branch Office, 215 North Street, Boston, Mass. Write for Circular showing method of supplying men.

JAMES C. WONDERS, *C. E.*, **Bellefontaine, O.** Highways and Municipal Work, Plans, Estimates, Specifications, Superintendence. Correspondence invited.

BARTLETT, GAY & YOUNG, Manchester, N. H., Water and Sewers.

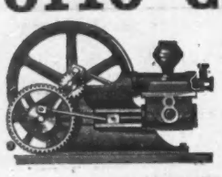
WM. GRIFFITH, Coal and Iron Exchange, Scranton, Pa.

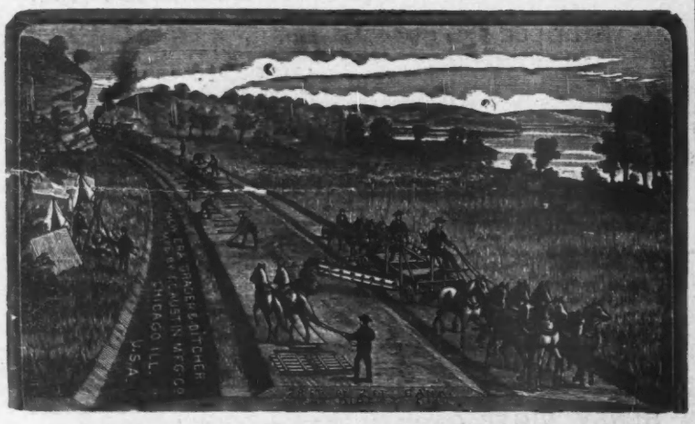
LANCASTER & LANCASTER, Norfolk, Va., Mines and Manufacturers.

HARVEY LINTON, Altoona, Pa., City Engineer.

COOKE & READ, Cleveland, O.

ROBERT POOLE & SON CO.,
ENGINEERS, FOUNDERS AND MACHINISTS,
MACHINE MOLDED AND PLANED **GEARING** OF ALL KINDS
SPUR, BEVEL, MITRE, MORTISE, ANGLE, HELICAL, WORM, INTERNAL
CORRESPONDENCE SOLICITED. CATALOGUES AND ESTIMATES FURNISHED. FACILITIES FOR THE HEAVIEST WORK.
WE HAVE UNEQUALED FACILITIES FOR THE PRODUCTION OF SPECIAL MACHINERY, AND SHALL BE PLEASED TO SUBMIT PRICES ON RECEIPT OF ENGINEERS' SPECIFICATIONS.
BALTIMORE, MD., U. S. A.

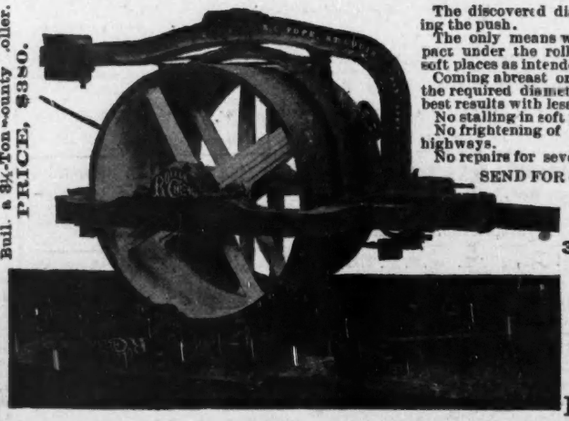
NOW READY.
OTTO GAS ENGINES For Use with

Gasoline, Coal Gas or Producer Gas.
SIZES, ⅛ TO 100 HORSE POWER.
Large Economy in fuel by our engines, combined with **Gas Producers,** giving One Horse Power for 1¼ lbs. of Anthracite Coal.
We contract for erection of Water-Works, Sewage Pumps, Electric Light Plants, Cable Road Stations, driven by Gas Power at Highest degree of economy.
OTTO GAS ENGINE WORKS.
151 Monroe St., Chicago. 18 Vesey St., New York.
33d and Walnut Sts., Philadelphia. 19 Pearl St., Boston.

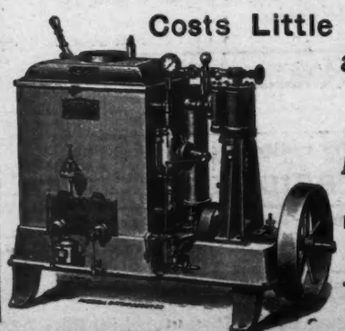

New Era Grader, Ditcher and Railroad Builder.
Inbuilding railroads makes cuts or fills embankments for 2 cents per cubic yard moving *1,000 to 1,500 cubic yards in 10 hours with six teams and three men.* Loads 600 to 800 wagons of 1¼ yards in same time at a cost of 2¼ cents each. Builds country roads at the rate of one mile in three days. We also make the Austin-Reversible Road Machine, Buck Scraper, Wheel and Drag Scrapers, Contractors' Plows and Street Sweepers. Send for catalogue.
F. C. AUSTIN MFG. CO., Chicago, Ill.

J. EDWARD ADDICKS, Pres. GEO. A. KELLY, Treas. ROBT. W. LYLE, Sec'y.
Staten Island Terra Cotta Lumber Co.,
—MANUFACTURERS OF—
SALT GLAZED VITRIFIED SEWER AND DRAIN PIPE AND FLUE LININGS,
Fire Brick, Ornamental Front Brick of all colors, Architectural Terra Cotta and POROUS TERRA COTTA or "TERRA COTTA LUMBER," and Hard Tile for Fire-Proofing Buildings.
MINERS AND SHIPPERS OF CLAY, FIRE MORTAR ETC.
This Company owns the exclusive right to manufacture POROUS TERRA COTTA or "TERRA COTTA LUMBER" in Middlesex County, N. J. and Richmond County, N. Y.
Offices: Equitable Building, 120 BROADWAY, NEW YORK.
Factories: WOODBRIDGE, N. J. Evening Address: HOTEL IMPERIAL, N. Y.

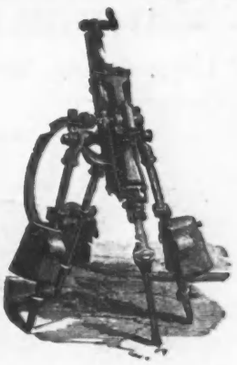
All GENUINE INGOTS & MANUFACTURES BEAR OUR REG. TRADE MARKS.
"Phosphor-Bronze"
PHOSPHOR-BRONZE
INGOTS, CASTINGS, WIRE, SHEET &c.
THE PHOSPHOR BRONZE SMELTING CO. LIMITED
512 ARCH ST. PHILADELPHIA PA. U.S.A.
ORIGINAL MANUFACTURERS OF PHOSPHOR-BRONZE IN THE UNITED STATES AND SOLE MAKERS OF "ELEPHANT BRAND" PHOSPHOR-BRONZE.

SEND FOR THIS BOOK
FREE ON APPLICATION.
THE BABCOCK & WILCOX CO
30 CORTLANDT ST. N.Y.
BRANCH OFFICES
BOSTON, MASS. 8 OLIVER ST.
PHILADELPHIA, PA. 32 N. 5TH ST.
PITTSBURGH PA 408 LEWIS BLOCK.
CLEVELAND, O. 412 PERRY-PAYNE BL.
CHICAGO, ILL. 45 S. JEFFERSON ST.
MINNEAPOLIS, MINN. 624 CORN EX.
NEW ORLEANS, LA. 57 CARONDELET ST.
HAVANA, CUBA.
WATER TUBE
STEAM BOILERS
MANUFACTORIES IN UNITED STATES, SCOTLAND, FRANCE, GERMANY & AUSTRIA.
Awarded the Grand Prize at the late Paris Exposition.

Pope's Reversible Street and Road Roller System
Overcoming All Objections to Steam Rollers and 90 Per Cent. Less Cost.

Built, a 3½-Ton Roller. PRICE, $380.
The discovered diameter overcoming the push.
The only means we have to compact under the roller and discover soft places as intended.
Coming abreast on one shaft with the required diameter produces the best results with less weight of roller.
No stalling in soft places.
No frightening of teams on public highways.
No repairs for seven years wanted.
SEND FOR CATALOGUE.
BUILD 3½, 5, 6, 7, 8, 9 AND 10-TON ROLLERS.
Address R. C. POPE,
Gen'l Office: 806 Chamber of Commerce Bldg., Chicago. Branch Office: Union Iron & Foundry Co., St. Louis.


Costs Little to Buy, Less to Run, and Nothing to Keep.
THE SHIPMAN
Automatic Steam Engine
1-2-4-6-8 HORSE POWER.
Burns Natural Gas, Kerosene, etc.
ANY ONE CAN RUN IT.
Write for Catalogues and Full Particulars.
THE SHIPMAN ENGINE COMPANY,
201 Summer St., Boston, Mass.

SPECIAL NOTICE.



Two handsome photo-engraved display sheets, entitled

"RECENT IMPROVEMENTS IN AIR COMPRESSORS,"
"RECENT IMPROVEMENTS IN ROCK DRILLS,"

Mailed free to any one who will cut out this advertisement and mail it to us with his name and address.

THE INGERSOLL-SERGEANT DRILL CO.,

10 PARK PLACE, NEW YORK.

BRANCH OFFICES:

114a Queen Victoria St., LONDON, E. C.
100-104 W. Washington St., CHICAGO, ILL.
203 St. James St., MONTREAL, CAN.
201-203 Congress St., BOSTON, MASS.
610 N. Fourth St., ST. LOUIS, MO.

26 S. Water St., CLEVELAND, O.
PARKE & LACY CO., San Francisco, Cal.; Sydney, Australia; Portland, Ore.; Spokane Falls, Wash.
THE STEARNS ROGER MFG. CO., Benj. B. Lawrence, Eng'r, Denver, Colo.

UTAH & MONTANA MACHINERY CO., Salt Lak City, Utah.
TUTTLE & MFG. AND SUPPLY CO., Anaconda, Butte, Missoula, Montana.
PHILIP & WIGGS MACHINERY CO., Birmingham, Ala.

AIR COMPRESSORS

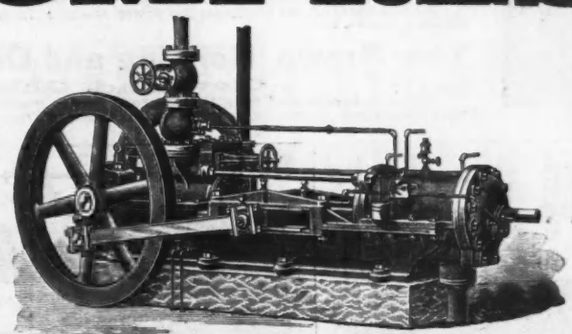
STRAIGHT LINE,

COMPOUND

—AND—

DUPLEX CORLISS

For All Pressures.



The only concentrated inlet of cold air through the piston.

The only inlet valve without springs or other than a single part.

The only Compressor with water jackets through the heads and all around the cylinder.

The only Compressor with an automatic unloading device.

Guaranteed to give the highest economy in the production of Compressed Air Power.

THE INGERSOLL-SERGEANT DRILL CO., 10 Park Place, New York.

—USED BY—

STERLING IRON & ZINC CO., Franklin Furnace, N. J.
MOUNT PLEASANT MINING CO., Port Oram, N. J.
PENOKEE & GOGEBIC DEVELOPMENT CO., Bessemer, Mich.

ST. BERNARD COAL CO., Earlington, Ky.
STURGIS COAL & COKE CO., Sturgis, Ky.
Mr. A. C. DOUGLAS, Niagara Falls, N. Y.
Messrs. BOOTH & FLYNN, Pittsburg, Pa.

CHAS. F. KING & CO., Ebervale, Pa.
THE DRAKE & STRATTON CO., Pittsburg, Pa.
HARRISON BROS. & CO., Philadelphia, Pa.
KEASBY & MATTISON, Ambler, Pa.
PENCOYD IRON WORKS, Philadelphia, Pa.

"RACKAROCK."

THE ONLY SAFE HIGH EXPLOSIVE.

It Contains No Glycerine or Gun Cotton. Cheapest, Best and Strongest.

Composed of two ingredients shipped and kept separate until required for use at the work.

240,000 LBS. USED IN FLOOD ROCK, HELL GATE, N. Y.

NO ACCIDENTS BY ITS USE IN ANY TUNNEL.

No Noxious Gases, No Headache, No Nausea. Fuzes, Caps and Electric Batteries.

RENDROCK POWDER CO., 23 Park Place, New York

Rock Drilling and Air Compressing MACHINERY

—FOR—

TUNNELS, QUARRIES, MINES, RAILROADS,
And wherever Ore and Rock are to be Drilled and Blasted.

RAND DRILL COMPANY,

23 PARK PLACE, NEW YORK.

BRANCH OFFICES: Monadnock Building, Chicago; Ishpeming, Mich.; 1316 18th St., Denver Sherbrooke P. Q., Canada; Apartado 830, Mexico City.

Everything That Bears Our Brand is of the Very Best Quality.

"Aetna" Explosives and Electric Blasting Appliances

Are Used Everywhere with the Highest Satisfaction.

SEND FOR CATALOGUE.

ÆTNA POWDER CO., Chicago.

A. O. FAY, Prest. W. B. LEWIS, Vice-Prest

· STEEL CASTINGS ·

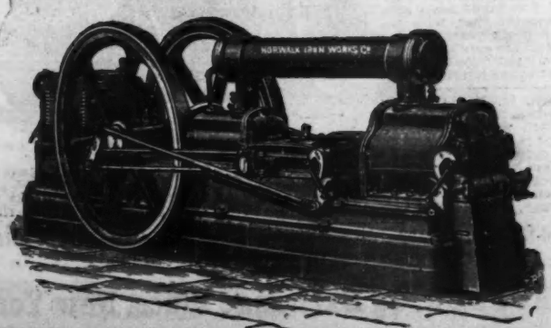
OPEN HEARTH AND CRUCIBLE

The Congdon Brake Shoe Co.

OFFICES AND FOUNDRIES: CHICAGO, ILL.

BRAKE SHOES

AIR COMPRESSORS.



VAILE & YOUNG'S

PATENT METALLIC

SKYLIGHTS.

WITHOUT PUTTY.

Peerless Construction for **Railroad Buildings, Factories,** etc., where **Large** and **Continuous Lights** are required. Thousand of feet in use.

THOMAS PROSSER & SON,
15 Gold Street, New York.

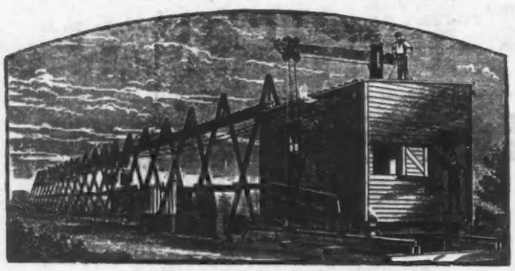
KRUPP'S STEEL TIRES

On Locomotive Driving Wheels.
GIVE THE BEST RESULTS
for Every Variety of Service.

BALDWIN LOCOMOTIVE WORKS.
ESTABLISHED 1831.
ANNUAL CAPACITY, 1,000.
PHILADELPHIA, PA.
BURNHAM, WILLIAMS & CO., Prop.
MANUFACTURERS OF
LOCOMOTIVE ENGINES,
Adapted to every variety of service, and built accurately to standard gauges and templates. Like parts of different engines of same class perfectly interchangeable.
COMPOUND LOCOMOTIVES.
PASSENGER AND GOODS LOCOMOTIVES.
Mine Locomotives, Narrow Gauge Locomotives, Furnace Locomotives, Steam Street Cars, &c.
All work thoroughly guaranteed.

POLLUTION OF STREAMS.—BY P. H. Bryce, M. D. A paper read at the National Conference of State Boards of Health, Lansing, Mich., June 6, 1892. "Passing over the spread of cholera by means of water as a generally accepted fact, the dissemination of typhoid fever may be said to be the crucial test of water pollution in temperate climates." An abstract of this excellent paper is published in ENGINEERING NEWS, June 30, 1892. Price, 15 cents.

ADVERTISE CONTRACT WORK
IN
ENGINEERING NEWS.



NEW AND COMPLETE SYSTEMS FOR HANDLING OF MATERIALS
The Brown Patent
Cable Tramway System.
Suspended Beam Tramway System.
Bridge Tramway System.
Shed Tramway System.
Warehouse Tramway System.
Sewer Machine Tramway System.
Continuous Elevated Tramway System
The Fayette-Brown Patent Automatic Furnace Hoist.
The accompanying cut illustrates the Sewer Machine Tramway System, for handling material excavated from trenches, sewers, etc.
The Brown Hoisting and Conveying Machine Co.,
Cleveland, Ohio, U. S. A.
Manufacturers and Sole Proprietors of the Patents, Applications and Designs under which the Brown Hoisting and Conveying Apparatus and the various Tramways for it are built.

Pittsburgh Locomotive and Car Works,
PITTSBURGH, PA.

WILSON MILLER Pres. & Treas. D. A. WIGHTMAN, Supt.

SPECIAL OFFER.

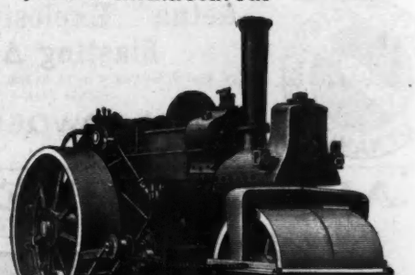
On application of any Railroad Contractor or Contractors' Engineer or Foreman mentioning this paper, we will mail, free of charge, our Sixth Edition Catalogue, containing dimensions, power and illustrations of Light Locomotives, Street Motors, etc., of all sizes and gauges of track. This catalogue contains information of value to all interested in railroad building and not published elsewhere. Apply to
H. K. PORTER & CO.,
Builders of Light Locomotives,
531 Wood St., PITTSBURGH, PA.
N. B.—Contractors' Locomotives kept on hand.

STEEL CASTINGS
True to Pattern, sound, solid, free from blow-holes and of great strength. Stronger and more durable than iron forgings in any position or for any service whatever. 20,000 KNUCKLES for M. C. B. Standard Car Couplers. 60,000 CRANK SHAFTS and 50,000 GEAR WHEELS of this steel now running prove this. Cross-Heads, Rockers, Piston-Heads, etc., for locomotives. STEEL CASTINGS of every description. Send for Circular and Prices to
CHESTER STEEL CASTINGS CO.,
Works, Chester, Pa.; Office, 407 Library Street, Philadelphia, Pa.

VERONA TOOL WORKS, TRADE MARK, PITTSBURG, PA.
METCALF, PAUL & CO
MAKE A SPECIALTY OF
SOLID STEEL
Railroad Track and Mining Tools.
ALSO SOLE MANUFACTURERS OF
The PATENT VERONA NUT LOCK
OVER 186,000,000 SOLD TO JAN. 1, 1892.
SEND FOR OUR NEW CATALOGUE.
Western Warehouse: 64 & 66 S. CLINTON ST., CHICAGO.
7th Av. & LIBERTY ST., PITTSBURG.

THACHER & BREYMANN,
Submarine Engineers and Divers.
Contractors for submarine work of all kinds where divers are required.
Recovering sunken property
Laying Submerged Pipes for Water Gas and Sewerage a Specialty
Estimates and Consultation promptly given. Correspondence solicited.
306 WATER ST., TOLEDO, O.

AVELING & PORTER'S
STEEL STEAM ROAD-ROLLERS.
More than 1,600 Manufactured.
STEAM ROAD ROLLERS with compound (high and low pressure) cylinders.
STEAM ROAD-ROLLERS with single (high pressure) cylinder. New and improved spring scrapers, new steering gear, new arrangement of driver's foot-plate, etc., etc.
Incomparably superior to any imitators in simplicity, workmanship, materials, and consequent durability.
At Auburn, N. Y., Boston, Mass., and Staten Island, N. Y., where imitations of Aveling & Porter's Rollers are in use, the most unsatisfactory results are reported, and the wear and tear and breakages have been greater in 12 months than with the Aveling Rollers in six years. Scores of similar reports are obtainable, and the broken-down imitation machines can be seen by anyone interested.



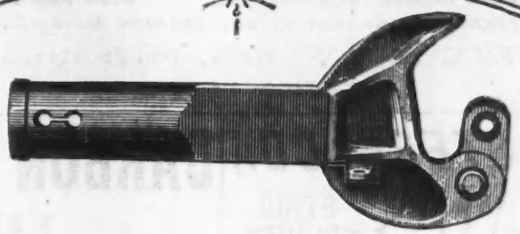
From Auburn, N. Y.—"Our new Roller is a rattle-trap already; the gear wheels are worn sharp; the crank-shaft is sprung; the gear is continually getting loose, and if the thing lasts out another year it will be doing well."
From Boston, Mass.—"Our Harrisburg Roller, bought in October, 1891, has cost between six and seven hundred dollars for repairs and renewals."
From Staten Island, N. Y.—"The Harrisburg Roller has been returned to the works very sick; tubes burned, gear worn out and wheels worn down, so that spokes are seen through rims."
Steam Road-Rollers, "Barnard-Castle" Street-Sweeping Machines Street Scraping Machines, Stone Crushers, etc., etc.
APPLY TO
W. C. OASTLER, 43 Exchange Place, New York.

TABLES OF MOMENTS OF INertia and Squares of Radii of Gyration; supplemented by others on the Ultimate and Safe Strength of Wrought Iron Columns. By Frank C. Osborn, C. E. Price $2. This standard book of Tables for Engineers and draftsmen engaged in structural work in iron and steel has attained so wide a popularity that recommendation is unnecessary. It is a necessity. For sale by Engineering News Publishing Co.

PLATE GIRDER HIGHWAY BRIDGE AT Brookline, Mass.—Designed and constructed by Alexis H. French, Town Engineer; Henry F. Bryant, C. E., being Asst. Engineer in Charge. A complete description of a plate girder skew bridge, with a clear span of 55 ft. 2½ ins. between copings and a width of 50 ft. Drawings of masonry abutments given and a double page insert showing details with all dimensions. To the young bridge engineer this example in design and construction is worth considerable. Published in ENGINEERING NEWS Sept. 19, 1891. Price, 15 cents.

THE COMPARATIVE MERITS OF VARIOUS SYSTEMS OF CAR LIGHTING. Price $1 postpaid.
303 pages, cloth bound, 5 × 6 ins., with 77 illustrations and complete index.
A full illustrated description of all the methods of railway car lighting now in use—oil, gas, gasoline and electricity—with particulars of the comparative cost, comparative safety, comparative convenience and comparative illuminating power.
This book is the only one ever published on this important subject. Railway officials investigating different systems of car lighting will find it an invaluable aid. It describes the best, safest and most economical practice with each of the systems of lighting. Many men in charge of gas, gasoline or electric car lighting plants will be enabled by the hints given in this book to introduce changes tending to greater economy and safety in the plants under their care. Published and for sale by Engineering News Publishing Co.

THE JANNEY FREIGHT CAR COUPLER



THE McCONWAY & TORLEY CO.

W. McCONWAY
PRESIDENT.

48th ST. & A.V.R.R. PITTSBURGH, PA.

Agents & Manufacturers For

THE JANNEY-HIEN COMPANY.

A. W. SOPER, PRESIDENT. ROB'T ANDREWS, VICE-PRESIDENT. R. M. DIXON, ENGINEER. C. H. HOWARD, SECRETARY. W. R. THOMAS, TREASURER.

The Safety

THE · HEATING · SYSTEMS.

BY HOT WATER CIRCULATION AND DIRECT STEAM WITH REGULATING DEVICES.
RELIABLE AND UNIFORM HEAT.
ECONOMICAL AND RAPID CIRCULATION.
GIBBS' AUTOMATIC COUPLER OF WESTINGHOUSE TYPE, ABSOLUTELY STEAM TIGHT.

THE · LIGHTING · SYSTEM.

THE CELEBRATED PINTSCH COMPRESSED OIL GAS METHOD
IN USE ON OVER 40,000 CARS IN EUROPE AND AMERICA.
THE BEST, MOST ECONOMICAL AND ONLY SAFE LIGHT FOR RAILROAD PURPOSES.
IN BRILLIANCY AND CLEANLINESS UNSURPASSED.
THIS SYSTEM HAS BEEN ADOPTED BY THE U. S. LIGHT-HOUSE BOARD FOR LIGHTING BUOYS.

Car Heating and Lighting Co.,

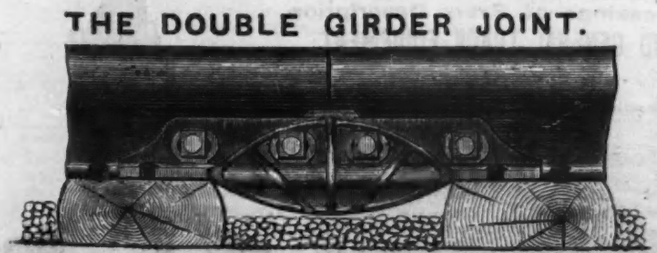
160 BROADWAY, NEW YORK.

THE PRICE RAIL JOINTS.

Offered by THE PRICE RAILWAY APPLIANCE COMPANY.

Office: No. 125 SOUTH FIFTH STREET, PHILADELPHIA, PA.

THE DOUBLE GIRDER JOINT.



THESE JOINTS consist of the **DOUBLE GIRDER JOINT**, the **SPOKE JOINT** and the **RIBBED TRUSS JOINT.** All of these **ABSOLUTELY ESCAPE** the **LEVERAGE** of the ordinary **SPLICE BARS,** and exhibit under severe test unusual **STRENGTH** and **ELASTICITY.** See, for an account of these, the issue of this journal of October 13, 1892. They have a **HORIZONTAL SEAT** as a support for the rails, in lieu of the inclined edge of a splice bar, and without adzing the Tie.

FOR FURTHER INFORMATION ADDRESS

JAMES M. PRICE,

125 SOUTH FIFTH STREET. - - PHILADELPHIA, PA.

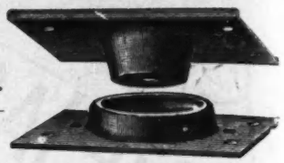
RIEHLE'S TESTING MACHINES. RIEHLE BROS. TESTING MACHINE CO., Store, 19 N. 6th St.; Works, 9th above Master, Phila. F. Y. Store, 96 Liberty St.

SCHOEN MANUFACTURING COMPANY,

Manufacturers of Articles in Pressed Steel for Railway and Car Construction

Pressed Steel Stake Pockets.
Pressed Steel Center Plates.
Pressed Steel Guide Bar Columns.
Pressed Steel Drawbar Attachments.
Pressed Steel Side Bearings.
Pressed Steel Corrugated Corner Bands
FOR GONDOLA CARS, AND
Push Pole Plates for Box Cars.

ADOPTED AS STANDARDS BY ALL LEADING ROADS.



MAIN OFFICE AND WORKS: PITTSBURG, PA.

PHILADELPHIA: 909 Drexel Building. CHICAGO: 314 Phenix Building. ST. PAUL: 132 Endicott Arcade.

PENNSYLVANIA STEEL CO.,

MAKER OF STEEL RAILS, STEEL SPLICES.

STEEL BLOOMS, BARS and FORGINGS. Capacity: 350,000 tons of Steel per Year.

Copyright 1895.

Steel Rail Frogs,

With the best and the most approved Improvements.

SPLIT SWITCHES, SWITCH STANDS, AND Fixtures for Stub Switches.

MAGNETO ELECTRIC ALARM SIGNALS For Crossings and Stations.

ELECTRICALLY OPERATED SEMAPHORE SIGNALS, Operated at any distance with absolute certainty.

The Largest Product of FROGS and SWITCHES in the Country

Ask for Prices before Ordering Elsewhere.

Works and Supt's Offices, STEELTON, PA
GENERAL OFFICE, 208 South 4th St., Philadelphia.
New York Sales Office, 2 Wall St
Boston Sales Office, 70 Kilby St

CARBON STEEL COMPANY,

PITTSBURG, PA.,

MANUFACTURERS OF

OPEN HEARTH STEEL

UNIVERSAL MILL PLATES.
SHEARED PLATES and SHEETS.
BOILER, SHIP and ARMOR PLATES.
Also NICKEL STEEL PLATES.

LIST OF SIZES SENT UPON APPLICATION.

AGENCIES:

L. b. BOOMER, 647 The Rookery, Chicago, Ill.
GEO. KINSEY & CO., 249 West Fourth Street, Cincinnati, O.
THE CONDIT-FULLER CO., Perry-Payne Building, Cleveland, O.
JAS. G. LINDSAY & CO., Bullitt Building, Philadelphia, P.

THE WEIR FROG CO. CINCINNATI O. FRED'K WEIR PRES.

SOLE MANUFACTURERS OF FRED'K G. WEIR'S IMPROVED RIGID & SPRING FROGS, CROSSINGS SINGLE & THREE THROW SPLIT SWITCHES. FIXED & AUTOMATIC SWITCH STANDS, STEEL DIE FORMED RAIL BRACES, SWITCH FIXTURES, ETC

CABLE & ELECTRIC TRACK WORK FROGS, SWITCHES CROSSINGS, CURVES RAIL CHAIRS ETC

OLD & NEW RAILWAY EQUIPMENT. A. S. MALES & CO. CINCINNATI OHIO CATALOGUE

CARLISLE MFG. CO.,

CARS, ENGINES, FROGS & SWITCHES.

CARLISLE, PA.

BOOKS. YOU CAN OBTAIN PROMPTLY the latest work on any subject in which you are interested by addressing ENGINEERING NEWS PUBLISHING CO., Tribune Building, New York City.

PASSENGER, FREIGHT TENDER. # HINSON COUPLERS

The Hinson Car Coupler Co.
518 Rookery, Chicago.
65 Boreel Bldg., N. Y

RAMAPO IRON WORKS,

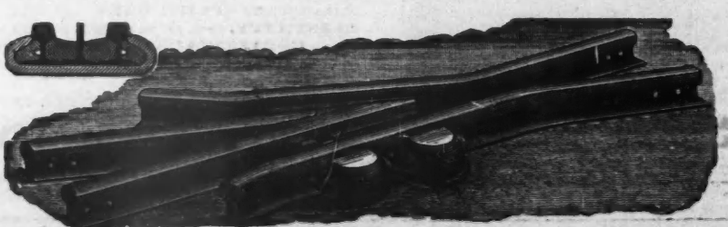
HILLBURN, ROCKLAND COUNTY, N. Y.

MANUFACTURERS OF

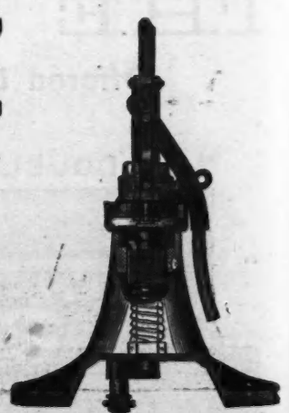
Switches, Automatic Safety Switch Stands, Yoked Frogs, Bolted Plate and Spring Rail Frogs, Automatic Distant Signals Interlocked with Switches, Crossings of Every Description.

LIGHT AND HEAVY CASTINGS AND GENERAL TRACK EQUIPMENT.

Automatic Stand, Showing Position of Bar while being thrown by Hand.



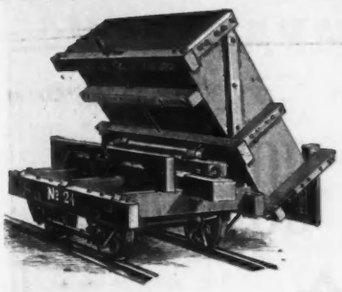
RAMAPO "YOKED FROG."

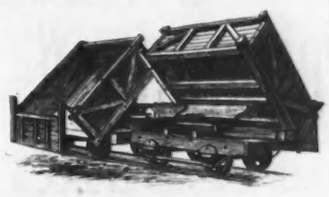


Automatic Stand, Showing Position of Parts while being thrown Automatically by train.

BLOOMSBURG CAR CO.,

BLOOMSBURG, PA.,





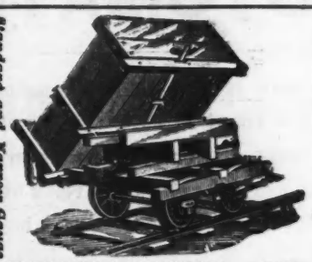
MANUFACTURERS OF

FLAT CARS, SIDE AND ROTARY DUMP CARS

Built Especially for Contractors, with or without Steel Linings.

CONTRACTORS'

Standard and Narrow Gauge Side and End Dump Cars, Flat and Quarry Cars, Platform and Rail Cars, Light Locomotives, Hoisting Engines, Steam and Hand Winches Drums, etc.



Manufactured by RYAN-McDONALD MFG. CO.
44 SOUTH STREET, BALTIMORE, MD.
Send for Illustrated Catalogue and Prices.

SPARKS & EVANS

CONTRACTORS

MASONRY A SPECIALTY.

436 Walnut St. Philadelphia, Pa.

THE COREY CAR & MFG. CO, CHICAGO, ILL.

COR. ASHLAND & CARROLL AV'S.

1¼ yd. car 31⅝ in above top of rail.

THE PAGE CAR.
THE LOWEST DUMPING CAR IN THE WORLD.
Three yd. car 42 in. above rail. Boxes dumping at angle of 50°. Doors quickly removed and replaced. Simple, strong and easily handled. Dumped by one man standing on car. Will stand any steam shovel. Unsurpassed for filling trestle.

Send for Descriptive Circular.

THE
Cockburn Barrow & Machine Co.,
MANUFACTURERS OF

NEW CONCRETE MIXER
234 to 240 Eleventh St., Jersey City, N. J.

ENGINEER'S
FIELD BOOK
BY C. S. CROSS, CIVIL ENGINEER.
THIRD EDITION.

To which is added much valuable information on Railroad Surveying and Construction, by the late Prof. Chas. A. Smith, C. E., of Washington University, St. Louis, Mo., Wm N. Shunk, C. E., and others.

COMPILED AND EDITED BY
GEO. H. FROST, C. E.

CONTENTS.

Method of Staking out and Keeping Field ules of Railroad Curves.
Railroad Curve Tables, for expeditiously determining the points at which to commence the Curving.
Keeping the Field Notes of a Railroad Survey from which the Center Line is Laid.
Excavation and Embankment; Application of the Prismoidal Formula.
Excavation and Embankment Tables.
Instructions to Division and Assistant Engineers relative to Field Notes on Surveys for the South Penna. R. R. Co.
Engineering Field Work. By the late Prof. Chas. A. Smith, of Washington University, St Louis, Mo.
Regulations for the Engineering Department during Construction, prepared for the South Penna. R. R. Co., by Wm. F. Shunk, C. E.
Howe Truss Bridges (Illustrated).
Table for Computing Right of Way Areas. Width 100 ft.
Pile Driving Machine (Illustrated).
Metric Railway Curves.

Price, 50 Cents.

Engineering News Publishing Co.,

EXTENSIBLE SEWER BRACE.

PATENTED JULY 8, 1890.

This brace is connected to the shoes by ball-bearing joints, which allow it to adjust itself to any angle the planking may assume. It is quickly and easily put in place, it takes up very small space in the trench, and being made of the very strongest material is absolutely safe. We will send one dozen on thirty days' trial. WRITE FOR CIRCULAR AND PRICES.

THE DUNN MFG. CO., Ltd., Branch Office, Lewis Bldg., PITTSBURG, PA

IF YOU ARE OPENING AN OFFICE for any specialty in engineering, in any city in America, it will be an advantage to you to have your name, address and specialty advertised in the ENGINEERING NEWS Directory of Engineers and Contractors. It is the largest and best directory of leading men in the profession published any where.

BABCOCK STREET PLOW
OR POWER PICK
For Hardpan and Street Work

Two teams will plow up the hardest street with ease, and do more work in any kind of hard ground than thirty men can do with picks.

MANUFACTURED BY
JOHN BABCOCK,
Walton, Del. Co., N. Y.

JAMES M. BROWN & CO.,
General Railway Contractors.
Estimates made on all classes of Engineering Work.
GENERAL OFFICES,
Boreel Building, 115 Broadway, New York.

GEO. B. CHRISTIE. JESSE LOWE.
GEO. A. LEDERLE.

Christie & Lowe,
CONTRACTORS.
Street Railways and Bridge Foundations.
Room 516, ASHLAND BLOCK,
CHICAGO, ILL.

JOHN CLAFFY,
MANUFACTURER AND DEALER IN
Contractors and Railroad Supplies
SOLE MANUFACTURER OF
Kelly's Patent Derrick Foot Blocks,
Guy and Cable Stretchers.
48 Dey Street, New York.

MAIRS & LEWIS, General Contractors,
No. 18 BROADWAY, NEW YORK.
GEO. C. MAC GREGOR, Engineer.
Heavy Timber Work a Specialty. Preliminary Reports and Locations Made.

McCORMICK CONSTRUCTION CO.,
100 W. WASHINGTON ST., Chicago, Ill., & ROOM 922 WAINWRIGHT BLDG., St. Louis, Mo.
Tunnels, Railways, Bridge Piers, Foundations, Water-Works, River Improvements, etc.
R. P. McCORMICK, President and Chief Engineer.

C. L. STEUBNER & CO.
SUCCESSORS TO
STEUBNER & WOODS.

Manufacturers of Self-Dumping Buckets for hoisting coal, stone, ores, etc.; Improved Self-Dumping Buckets for hoisting mud and wet sand; Patent Bottom Dumping Buckets; Side and Bottom Dumping Cars; Charging Cars and Barrows; Iron and Steel Wheelbarrows; Iron Hoisting Blocks.
LONG ISLAND CITY, N. Y. 109 & 170 THIRD STREET
Send for Circular and Price List.

E. WOLTMANN. GEO. T. KEITH, M. Am. Soc. C. E.
WOLTMANN, KEITH & CO., 11 Wall St., New York,
Engineers and Contractors for Water-Works, etc.

J. F. MOFFETT, Pres't; J. V. CLARKE, C. E., Treas. H. C. HODGKINS, C. E., V. P.; C. T. MOFFETT
MOFFETT, HODGKINS & CLARKE CO., Engineers and Contractors,
16-22 William St., New York. 720 Opera House Block, Chicago
SPECIALTIES: Construction of Water-Works, Gas Works, Electric Lighting, and Sewerage in Cities and Towns. Also, General Railroad Engineering and Construction. Plans, Specifications and Estimates prepared.

Automatic Register
The most accurate and reliable counter manufactured. Made entirely of metal.

Handsomely finished. Can be used on any machine. Send for circular.
G. EDW. OSBORN & CO.,
393 State St., New Haven, Conn.

RELIANCE
HYDRAULIC JACKS.

MADE IN FOUR SIZES
10, 15, 20 and 30 ton capacity, to lift 13 or 18 inches, Broad Base or Ground Lift.
SUPERIOR TO ANY JACK NOW MADE.
Absolute in its actions in any position.
Under complete and instantaneous control

DIENELT & EISENHARDT Mkrs.
1836 Howard St., PHILADELPHIA.

BOOKS YOU CAN OBTAIN PROMPTLY the latest work on any subject in which you are interested by addressing ENGINEERING NEWS PUBLISHING CO., Tribune Building, New York City. BOOKS

GEO. WESTINGHOUSE, JR., President | T. W. WELSH, Supt. | JOHN CALDWELL, Treasurer. | W. W. CARD, Secretary. | H. H. WESTINGHOUSE, General Manager.

THE WESTINGHOUSE AIR BRAKE COMPANY,

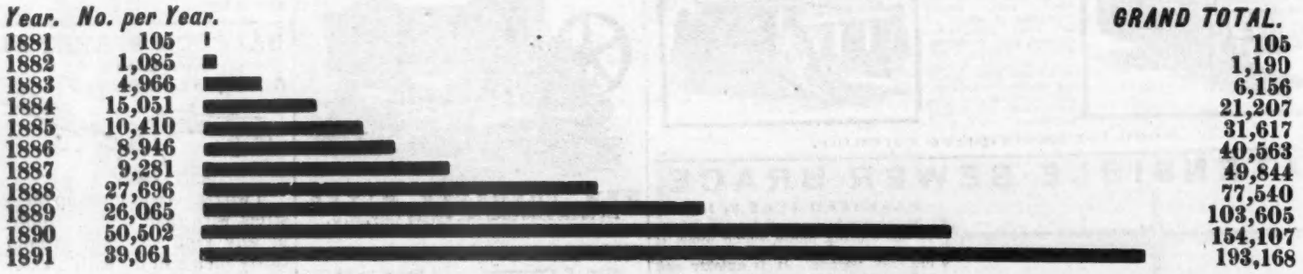
PITTSBURGH, PA., U. S. A.

MANUFACTURERS OF THE

WESTINGHOUSE AUTOMATIC BRAKE

The WESTINGHOUSE AUTOMATIC BRAKE is now in use on 24,000 engines and 325,000 cars. This includes (with plain brakes) 232,000 freight cars, which is about 23 PER CENT. of the Entire Freight Car Equipment of this country, and about 80 per cent. of these are engaged in interstate traffic, affording an opportunity of controlling the speed of trains by their use on railways over which they may pass. Orders have been received for 173,000 of the Improved Quick-Action Brakes since December, 1887.

The best results are obtained in freight train braking from having all the cars in a train fitted with power brakes, but several years' experience has proven conclusively that brakes can be successfully and profitably used on freight trains where but a portion of the cars are so equipped. Below is a graphical illustration of the progress made in the application of the Automatic Brake to freight cars since its inception.



193,168 freight cars fitted with the Westinghouse Automatic Brake, which is nearly 20 per cent. of the Entire Freight Car Equipment of this country.

E. L. ADREON, Manager | JOHN B. GRAY, Agent. | C. C. HIGHAM, General Supt.

THE

AMERICAN BRAKE COMPANY.

NEW YORK OFFICE: 60 Broadway JOHN B. GRAY, Agent.

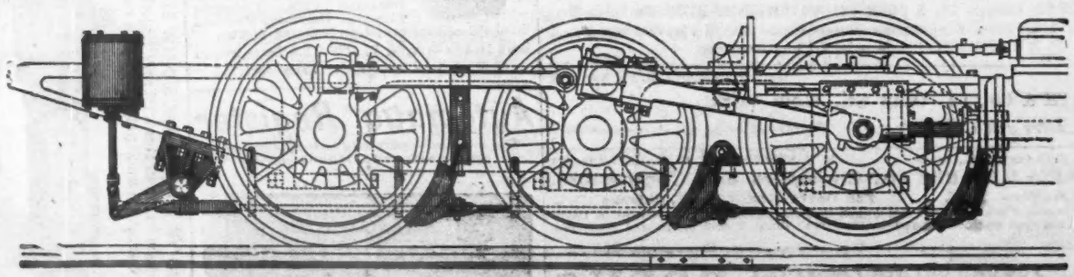
THE WESTINGHOUSE AIR BRAKE CO., Lessee,

MANUFACTURERS OF

CHICAGO OFFICE: GRAND PACIFIC HOTEL.

LOCOMOTIVE BRAKES.

General Offices and Shops: Second and Tyler Sts., ST. LOUIS, MO., U. S. A.



Standard Outside Equalized Pressure Brake, for two or more pairs of Drivers, furnished to operate with either STEAM, AIR or VACUUM.

NUMBER SOLD, OVER 22,000.

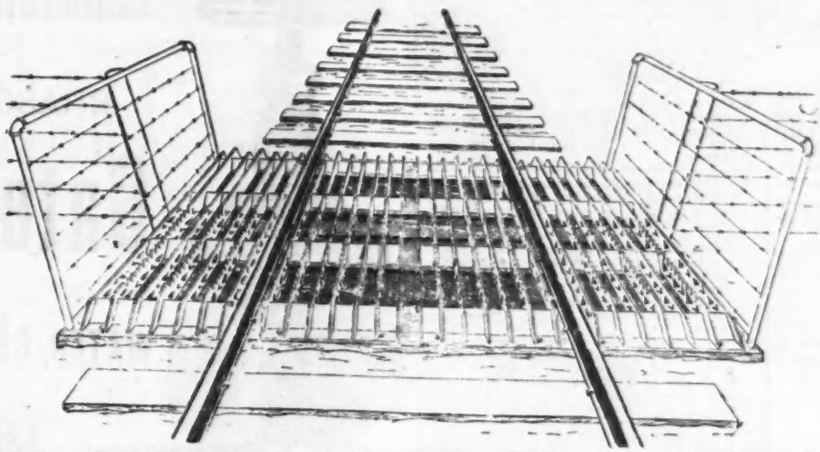
WHY

Are there twice as many

NATIONAL

Guards in track as of all others combined?

WRITE FOR CATALOGUE.



BECAUSE

7 YEARS'

Testing has proved it to be the most

Effective Stock Turner.

Material and Workmanship and Mechanical Principle Correct.

THE NATIONAL SURFACE GUARD CO., 445 Rookery, Chicago.

STEEL SURFACE CATTLE GUARDS

MANUFACTURED BY

BUSH CATTLE GUARD CO.

KALAMAZOO, MICH.

PRICE $20.00.

PATENTED JULY 15, 1890.

Any Gage for Road and Single or Double Track.

CORRESPONDENCE SOLICITED.

MALCOLM D. PATTERSON, *Civil Engineer,*
ROOM 3, BOROUGH HALL, NORRISTOWN, PA.
Surveys for Railroads, Water-Works, Bridges, Sewerage. Plans and Estimates Furnished and Construction Superintended. Examination and Reports Made on Railroad, Mining and Other Properties.

D. W. CHURCH, 1504 Monadnock Bldg., Chicago, Ill.
Consulting Civil Engineer.
Buildings, Structural Work, Heavy Foundations, Etc.

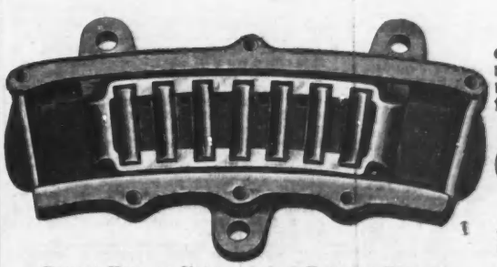
Cooper's Specifications of
Iron and Steel Railroad Bridges, 25 cents.

Coopers' Specifications of
Iron and Steel Highway Bridges, 25 cents.

THE NEWEST BOOKS on Scientific and Technical Subjects promptly supplied, on receipt of price, by ENGINEERING NEWS PUBLISHING Co., Tribune Building, New York. Send for Catalogue.

HUBBARD

Anti-Friction Side Bearings.



BOTTOM VIEW OF UPPER OR ANTI-FRICTION BEARING.

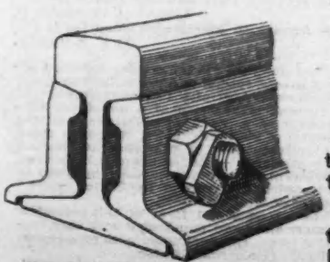
One of the most effective and economical improvements ever made for car trucks.

SAMPLE FREE.

Car Truck Supply Company,
1007 Monadnock Bldg.,
CHICAGO.

Young's Patent Reversible Lock Nut.

Patented in United States and Abroad.

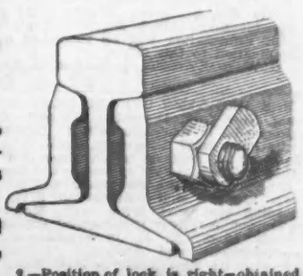


1.—Position of lock is wrong—gravity would loosen it.

One defect of the spring washer type of nut lock is the liability to overload the spring to such a degree as entirely to destroy its elasticity, when it becomes simply a flat washer and its use as a lock is then lost.

The Young Patent Reversible Nut Lock is not a spring and therefore cannot deteriorate in use.—THE RAILROAD GAZETTE, Nov. 11, 1892.

150 BROADWAY, ROOM 31, NEW YORK.



2.—Position of lock is right—obtained by turning outer face of lock (cut 1) toward nut.

Cast Iron Pipe, Specials Etc.

STAND PIPE AND STEAM PUMPING MACHINERY.

Sealed proposals are invited until 12 o'clock noon, January 12, 1893, for furnishing CAST IRON PIPES, SPECIAL CASTINGS, VALVES AND HYDRANTS; and for LAYING THE SAME; also until 12 o'clock noon, January 19, 1893, for ERECTING STAND PIPE, ENGINE AND BOILER HOUSE, and STEAM PUMPING MACHINERY PLANT; and for SINKING ARTESIAN WELLS and PUMPING CISTERN; for the Keyport Water Commissioners, Keyport, N. J.

The right is reserved to reject any or all proposals. Each bid must be accompanied by a certified check. A penalty or forfeiture will be required for failure to complete each contract within the specified time. No extra allowance, above the contract price, will be made under any pretext whatever. Specifications and plans may be seen at Keyport, N. J., or at 1404 North 12th street, Philadelphia, Pa.

RUFUS OGDEN.
THOS. H. ROBERTS.
CORNELIUS ACKERSON.
Water Commissioners, Keyport, N. J.

ISAAC S. CASSIN & SON,
Engineers, Keyport (N. J.) Water Works,
Philadelphia, Pa.
PHILADELPHIA, Pa., Dec. 17, 1892. 53-2t

NOTICE TO SEWER CONTRACTORS.

Sealed proposals for the construction of a system of sewers for the village of Hoosick Falls, N. Y., will be received by the Board of Sewer Commissioners until Tuesday, Feb. 7, 1893, at 8 p. m. in the office of the Clerk of the Board. Plans are now on file in said office, and specifications, proposal blanks and other information may be had on application.

The board reserves the right to reject any or all bids.

LYMAN C. WILDER,
Clerk of Board of Sewer Commissioners.
JOSEPH BUCKLEY,
President. 53-2t

PROPOSALS FOR SUPPLIES FOR THE Navy Yard, Washington, D. C.—December 8, 1892.—Sealed proposals, endorsed "Proposals for Supplies for the Navy Yard, Washington, D. C., to be opened December 28, 1892," will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, December 28th, 1892, and publicly opened immediately thereafter, to furnish at the Navy Yard, Washington, D. C., a quantity of castings, hardware, belting, tools, steel, timber, glass, paints, electrical supplies, railroad ties, gas globes, rope, cement, lime, plumbers' supplies, and wire gauze. Blank proposals will be furnished upon application to the Navy Yard, Washington, D. C., or to the Bureau. The attention of manufacturers and dealers is invited. Tie bids, all other things being equal, decided by lot. The Department reserves the right to waive defects or to reject any or all bids not deemed advantageous to the Government. EDWIN STEWART, Paymaster-General, U. S. Navy. 52-3t

TREASURY DEPARTMENT, OFFICE Supervising Architect, Washington, D. C., December 20, 1892.—The time for opening the proposals for the trench excavation, concrete and stone footings, cut stone work and brick work of basement and area walls of the United States Post-Office, Court House and Custom House at Milwaukee, Wisconsin, is hereby extended until 2 o'clock p. m. on the 10th day of January, 1893. JAMES P. LOW, Acting Supervising Architect. 53-2t

UNITED STATES ENGINEER OFFICE, Room 48, Appeal Building, Memphis, Tenn., December 24, 1892.—Sealed proposals in triplicate, for the construction of the following named levees will be received at this office until 12 o'clock, noon, of January 19, 1893, and then publicly opened, viz.: Upper White River Levee District: (1), From vicinity of stake 1,120 (XX. 358, R), where this year's work ends, to stake 1160, about 91,400 cu. yds; (2), From stake 1160 to take 1,200, or as far as the funds will go, about 110,000 cubic yards. Lower White River Levee District; (3), From vicinity of stake 1,110, where this year's work ends (632, R), to vicinity of stake 1,205, about 150,000 cubic yards; (4), From stake 1,205 to vicinity of stake 1,225, or as far as the funds will go, about 175,000 cubic yards. Specifications, blank forms and all available information will be furnished on application to this office.

S. W. ROESSLER, Captain of Engineers. 53-3t

U. S. ENGINEER OFFICE, ARMY BUILDing. New York, December 21, 1892.—Sealed proposals, in duplicate, will be received at this office until 12 o'clock, noon, Tuesday, January 24, 1893, at which place and time they will be publicly opened in the presence of bidders, for the manufacture of mechanism for gun and ammunition lifts, with loading apparatus, for a 12-in. high-power gun, and for their satisfactory erection at Sandy Hook, N. J., in accordance with specifications and drawings, which may be seen on application to this office. The attention of bidders is invited to Acts of Congress approved February 26, 1885, and February 23, 1887, Vol. 23, page 352, and Vol. 24, page 414, Statutes at Large. G. L. GILLESPIE, Lieut.-Col. of Engrs. 53-4t

WANTED—Position after Jan. 1 by young C. E. with seven years' extensive and varied experience on important hydraulic works, water supply and city sewerage. Would prefer drafting (work done with neatness and expeditiously), but willing to undertake either field or office work. First class references. Address "X. Y. Z," care Engineering News. 53-3t

WANTED—A position on location or construction by experienced engineer; just finished work on trunk line. Has transit level, etc. Address R., care Eng. News. 53-3t

WANTED—Position by young man; good references; University graduate; two years of hard, practical experience. Address "H. P.," care Eng. News. 53-3t

WANTED.—A graduate engineer desires position as assistant engineer or draftsman; several years' experience with leading bridge companies on structural work; well up in figuring strains, details and shop drawings. A. P. J., care Eng. News. 53-3t

A GRADUATE civil engineer desires a position at instrumental work in New York city or vicinity; has had one year's experience in engineering; has been employed at Government work, which is just terminated, and is now open to engagement; age 28. F. F. M., care Eng. News. 53-1t

A CIVIL ENGINEER, age 30, whose experience has been nearly all city work, wants an engagement, South or West preferred. Would design and take charge of construction of sewerage system. First class draftsman. Complete set of instruments. Address SEWERS, care of Engineering News. 53-3t

WANTED—Position as assistant or independent engineer by a young man with good education and 13 years' practical metallic, hydraulic and railway construction in different countries; speaking several languages and accustomed to travel. CHAS. STEINER, care Eng. News. 53-4t

WANTED—A good reliable surveyor for city work. Address "SURVEYOR," Box 394, Providence, R. I., giving age, experience, etc. 53-3t

FOR SALE—Engineering News, last nine volumes, from July 7, 1888, to Jan., 1893, unbound, with indices, price $2.50 per volume; or will accept best offer received by Feb. 1, 1893. I. S. DUNNING, Aurora, Ill. 53-2t

WANTED—ENGINEERING NEWS of the following dates:
1890—Feb. 28;
1892—March 18, and Jan. 21;
1894—July 5;
1887.—March 19 and Index to Vol. XVII.
One Cross' Engineer's Field Book, or any single number of the Van Nostrand Science Series, for each copy of the paper above advertised.

WANTED—Indices to Engineering News for volumes 17, 23, 24, 25. Will pay same as in last advertisement.

WANTED—Engineering News for Oct. 22, 1881. Will pay 20 cts. ENG. NEWS.

WANTED—Engineering News for July 5, 1884; Index to Vol. 25. Will pay 15 cents each. ENGINEERING NEWS.

WANTED—Engineering News of July 4, 1885. Will pay 12 cts. ENG. NEWS.

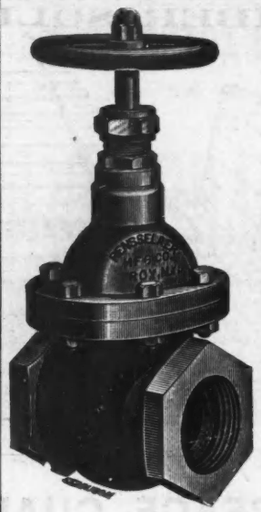
WANTED—Engineering News for Jan. 7 and Feb. 4, 1888; will pay 12 cents each if in good condition. ENGINEERING NEWS.

WANTED—Engineering News for 1892, Nos. 2, 4, 7, 8, 24, 28, 32, 33, 59; for sets of these numbers delivered at this office we will send free of charge, one copy of Baumeister's "Cleaning and Sewerage of Cities," price, $2.50, or we will advance any subscription now on our list, 3 months; for any single copies we will send postpaid, one copy of Cross' Engineer's Field Book. The advertising pages may be removed, but colored cover retained. Wrap the long way of the paper, and so as to preserve the edges. Mutilated or soiled papers are of no value to us whatever. Bill us on postal card for papers sent. ENGINEERING NEWS PUB. CO.

BACK NOS. OF ENGINEERING NEWS. In the efforts to complete volumes for subscribers, we have accumulated quite a stock of back numbers of Engineering News, although in no case a full year. We have odd numbers from 1879 to date, in each of the intervening years, and a few indexes. Any number is for sale at 15 cents, and money must accompany the order in each case, as there is no margin for correspondence or bookkeeping, the total possible amount to be realized being very insignificant as compared with office room and time given up to the matter. But the volumes of Engineering News are growing in value, and, being the only record of American Engineering for 15 years past, they are worth preserving. Address ENGINEERING NEWS PUBLISHING CO., Tribune Building, New York City.

FOR SALE.—ENGINEERING (London), for 1885, 1886, 1887 and 1888 complete. Price for the lot $20. ENGINEERING NEWS PUBLISHING CO.

WHENEVER you need a Book or any information about Books, write to ENGINEERING NEWS PUBLISHING CO. for their new Catalogue.



RENSSELAER MFG. CO.

BRASS AND IRON

Gate Valves

FOR

WATER, GAS, STEAM AND OIL.

TROY, N. Y.

BOURBON COPPER and BRASS WORKS
PATENTED
Fire Hydrant and Stop Valves.
Also Manufacturers of
COPPER AND BRASS GOODS OF EVERY DESCRIPTION.
202 and 204 East Front Street, - - - CINCINNATI, O.

ESTABLISHED 1844.
A. SCHRADER & SON.
MANUFACTURERS OF
Submarine Armor
AND
Diving Apparatus.
12 ROSE ST., NEW YORK
IMPROVED BOLT HELMET

ADVERTISE CONTRACT WORK IN ENGINEERING NEWS.

BUILDINGS AND STRUCTURES
—OF—
AMERICAN RAILROADS.

A REFERENCE BOOK
—FOR—
Railroad Managers, Superintendents, Master Mechanics, Engineers, Architects and Students,
By WALTER G. BERG, C. E.,
Principal Assistant Engineer
Lehigh Valley Railroad.

4to, Cloth. 534 Pages. 700 Illustrations. $7.50.

LIST OF CONTENTS.

	No. of Illustrations.
Preface	
Chapter I. Watchman's Shanties	16
II. Section Tool Houses	23
III. Section Houses	31
IV. Dwelling Houses for Employés.	17
V. Sleeping Quarters, Reading Rooms and Club Houses for Employés	12
VI. Snow Sheds and Protection Sheds for Mountain Slides	13
VII. Signal Towers	15
VIII. Car Sheds and Car Cleaning Yards	13
IX. Ash Pits	16
X. Ice Houses	17
XI. Sand Houses	15
XII. Oil Storage Houses	25
XIII. Oil Mixing Houses	32
XIV. Water Stations	21
XV. Coaling Stations for Locomotives	37
XVI. Engine Houses	46
XVII. Freight Houses	51
XVIII. Platforms, Platform Sheds and Shelters	20
XIX. Combination Depots	54
XX. Flag Depots	34
XXI. Local Passenger Depots	146
XXII. Terminal Passenger Depots	60
Appendix: Specifications, Contracts and Blank Forms.	

JOHN WILEY & SONS,
Scientific Publishers, New York.

VAN DUZEN'S Steam JET PUMP
PUMPS ANY KIND OF LIQUID.
Does not clog, freeze or get out of order. Always ready. All brass. Every Pump Guaranteed. 10 sizes. Capacity 100 to 10,000 gallons per hour. Prices $7 and upwards. For full information write to
The VAN DUZEN & TIFT CO.
(PUMP DEPARTMENT)
CINCINNATI, O.

"The Great Industrial Review."
THE Engineering Magazine.

To applied science just what *The Century* and *Harper's* are to literature—a high-class, elaborately illustrated monthly magazine, written by the foremost men of our times. Now in its fourth volume, it has achieved a success which is without a parallel in all the history of technical literature. Its scope is universal, its contributors include men of international reputations, it is read wherever the English language is spoken, and a distinguishing feature which renders it simply invaluable to busy men the world over is a complete monthly index to all "Current Technical Literature."

S. L. Randolph, Engineer of Tests B. & O. R. R., says of this: "I consider it the greatest step that has been taken in recent years toward systematizing the work of the engineer."

The December number contains:

Benefits of Reciprocity with Canada. ERASTUS WIMAN.
Architecture in Wood—A Protest. GORDON B. KIMBROUGH
Building the Cable-Road in New York. Illustrated. GEORGE IKES.
Industrial Development of the South. III.—TYPES OF RECENT PROGRESS. R. H. EDMONDS.
Our Remaining Hard-Wood Resources. CHARLES MOHR.
The Irrigation Problem in the West. Illustrated. H. M. WILSON, M. Am. Soc. C. E.
Labor Troubles and the Tariff. CHARLES J. HARRAH.
The Gold-Fields of Bendigo, Australia. Illustrated. J. F. MARKES.
The World's Fair and the Death Rate. JAMES C. BAYLES, Ph. D.
Are American Mechanics Boastful? T. F. HAGERTY.

"Contains well-written articles—profusely illustrated—of special interest to Railway men."—*Melbourne* (Australia) *Railways Gazette.*

"Possessing the charm of a novel, the thoroughness of a work of reference, and the accuracy of a statist's tables, its pages reach an excellence both in substance and diction rarely attained."—*The Quadrangle*, Melbourne.

"It has made an unprecedented headway in the technical literature of the United States."—*The Age of Steel*, St. Louis.

"The strength and force of this periodical are more and more manifested with each successive issue. It is conducted with remarkable ability."—*The Herald*, Boston.

$3 a year. All news-stands or by mail. Sample Copy free—mention this paper.

The Engineering Magazine Co.
WORLD BUILDING, NEW YORK, U. S. A.

THE LUDLOW VALVE MANUFACTURING CO.

Factory and Office: 938 to 954 River St, and 67 to 83 Vail Ave.

TROY, N. Y., U. S. A.

MANUFACTURERS OF

Valves and Fire Hydrants.

DOUBLE AND SINGLE GATE VALVES,

½-inch to 60-inch,

FOR LIGHT AND HEAVY PRESSURE.

—ALSO—

Vertical and Horizontal Check Valves,

Foot Valves, Air Valves, and Yard and Wash Hydrants.

SEND FOR CATALOGUE.

Ross Mobile Wedge Gate Valve.

PATENTED DECEMBER 9, 1890.

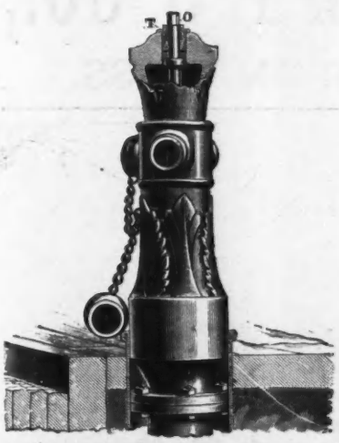
A NEW DEPARTURE in Valves, by means of the *rolling* action of the *movable* Wedge, the pressure to close the valve is applied over the *entire back* of the gates. The advantage is *operates easier; it shuts tighter, and lasts longer.* The gates are free to *revolve*, and are interchangeable and can be renewed. Order sample and compare with valves you are using.

Made in All Pipe Sizes by

THE ROSS VALVE CO.,

OAKWOOD AVENUE, TROY, N. Y.

THE HOLYOKE



FIRE HYDRANT.

Simple,

Durable,

Satisfactory

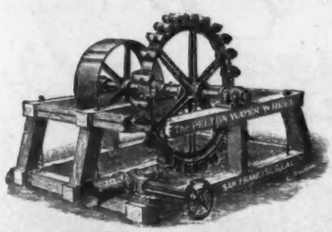
IN EVERY RESPECT.

SEND FOR CIRCULARS.

Holyoke Hydrant & Iron Works,

HOLYOKE, MASS.

THE PELTON WATER WHEEL



Embracing in its variations of construction and application the

Pelton System of Power.

The only distinctively new and important development relating to Hydraulic Power that has been made in the last half century. Adapted to all conditions and every variety of service where a head of 20 ft. or more can be obtained.

MORE THAN 2,000 WHEELS NOW RUNNING.

Shipments made from New York or San Francisco, as may afford the most favorable freight rates.

Write for Catalogue.

143 Liberty Street, New York City, or 121 Main Street, San Francisco, Cal.

WATER MOTORS.

THE BACKUS MOTOR is the cheapest power known for driving all kinds of light machinery. Scientific tests prove it to be superior to all other motors. Water Companies advise the Backus. It stands without an equal. Agents wanted. Send for special circular to

BACKUS WATER MOTOR CO., Newark, N. J.

Bouscarens Specifications of Iron and Steel Highway Bridges, 25 cents

Bouscaren's Specifications of Iron and Steel Highway Bridges, 25 cents

Chapman Valve Mfg. Co.

MANUFACTURERS OF

STEAM, GAS AND WATER

VALVES AND GATES

FIRE HYDRANTS,

WITH OR WITHOUT INDEPENDENT VALVE

All Valves and Hydrants furnished with BABBITT METAL SEATS and

NON-CORROSIVE WORKING PARTS

GENERAL OFFICE AND WORKS:

Indian Orchard, Mass.

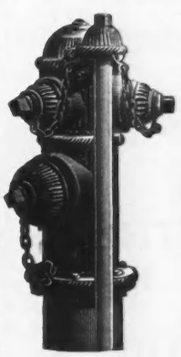
TREASURER'S OFFICE

72 Kilby Street, Boston, Mass.

CHICAGO OFFICE: 24 WEST LAKE ST.

ALL WORK GUARANTEED.

The GENUINE CHAPMAN VALVES in all cases will bear our name in full, either rolled in or cast upon the shell, and also our Trade-Mark and Monogram.



THE BEAUMONT FIRE HYDRANT

Is simple, durable, frostproof, inexpensive and in efficiency unapproachable.

The valves are of the best gun metal. It has a very superior positive waste valve. All hydrants are tested to 200 lbs. hydraulic pressure.

It will deliver a fire stream of larger volume and greater force than any other hydrant; a most valuable feature in gravity systems.

Adopted by U. S. Government, State of Illinois, and many others.

Recommended by National Association of Fire Engineers, 1888.

Extract from appendix to report on hydrant tests, by Selim H. Peabody, Ph. D., LL. D., Regent University of Illinois:

BEAUMONT.....	6.2	Friction loss per cent. in lbs. per square inch in hydrants used without nozzle, 50 feet of hose.
LUDLOW [gate]....	25.5	
CREGIER [comp.]..	37.8	

Send for Full Report.

RICHARD BEAUMONT, Manufacturer,

KANKAKEE, ILL.

MICHIGAN BRASS & IRON WORKS,

MANUFACTURERS

CONICAL COMPOUND WEDGE GATE HYDRANT.

VALVES

FOR WATER, STEAM, GAS AND OIL.

General Office and Works. **DETROIT, MICHIGAN.**

Branch House, 199 Lake St., Chicago, Ill.

Send for Circulars.

THE EDDY VALVE CO.

Waterford, New York

STRAIGHTWAY VALVES. FIRE HYDRANTS.

GENERAL WESTERN AGENTS, JAMES B. CLOW & SONS, CHICAGO, ILL.

SUMNER & GOODWIN,

5 to 21 Oliver Street, Boston.

MANUFACTURERS AND JOBBERS OF

WROUGHT IRON PIPE,

STEAM GAS AND PLUMBING MATERIALS

Water Works Supplies a Specialty

THOMSON METERS

SOLD AND DELIVERED

PROGRESS OF MANUFACTURE.

November,	1887, - - -	680 Meters.
"	1888, - - -	2,680 "
"	1889, - - -	4,860 "
"	1890, - - -	10,000 "
"	1891, - - -	20,000 "
"	1892, - - -	33,000 "

OFFICE AND FACTORY

83 WASHINGTON STREET,

BROOKLYN, N Y.

OIL WELL SUPPLY COMPANY,

OWNERS OF THE

ELBA IRON WORKS, CONTINENTAL TUBE WORKS,

AND SIX OTHER MANUFACTORIES MAKING

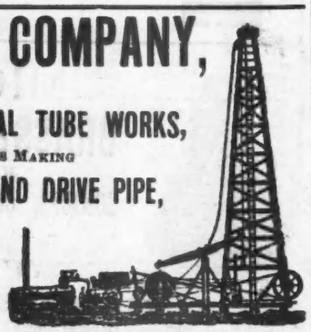
WROUGHT IRON STEAM, LINE AND DRIVE PIPE,

Tubing, Casing, Boilers, Engines, Drilling Rigs, Tools, Rope,

And other appliances necessary for Drilling Oil, Gas and Water ARTESIAN WELLS.

PITTSBURG, OIL CITY AND BRADFORD, PA.,

Also 32 CORTLANDT ST., NEW YORK.



FREE.

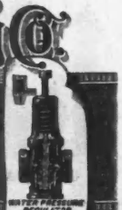
An Interesting and Instructive Pamphlet on Lubrication, by means of pure, flake graphite. It is scientific and practical.

JOS. DIXON CRUCIBLE CO., Jersey City, N. J.

H. Mueller Mfg. Co.

MANUFACTURERS OF

WATER AND GAS SPECIALTIES



Office & Manufactory,

220-222 E. MAIN ST.

DECATUR, ILL.

OUR GOODS CAN BE PURCHASED FROM ANY PLUMBING, WATER OR GAS WORKS SUPPLY HOUSE.

WATER PRESSURES.—If you want to get a list of the Pressures of all the Water-Works Systems in the United States and Canada, you can find them in the Manual of American Water-Works for 1890, published by Engineering News Publishing Co., Tribune Building, New York, and for sale at Three Dollars per copy, delivered.

WELL MACH'Y

All Kinds, Water, Gas, Oil, Mining, Ditching, Pumping, Wind and Steam; Heating Boilers, &c. We'll pay you to send 25c. for Encyclopedia of 1,500 Engravings.

The American Well Works, Aurora Ill.

Also Chicago, Ill.; Dallas, Tex.; Sydney, N. S. W.

THE HERSEY IS GUARANTEED For 5 Years

THE FAVORITE

Represented by

JAS. B. CLOW & SON, CHICAGO.

N. O. NELSON MFG. CO., ST. LOUIS.

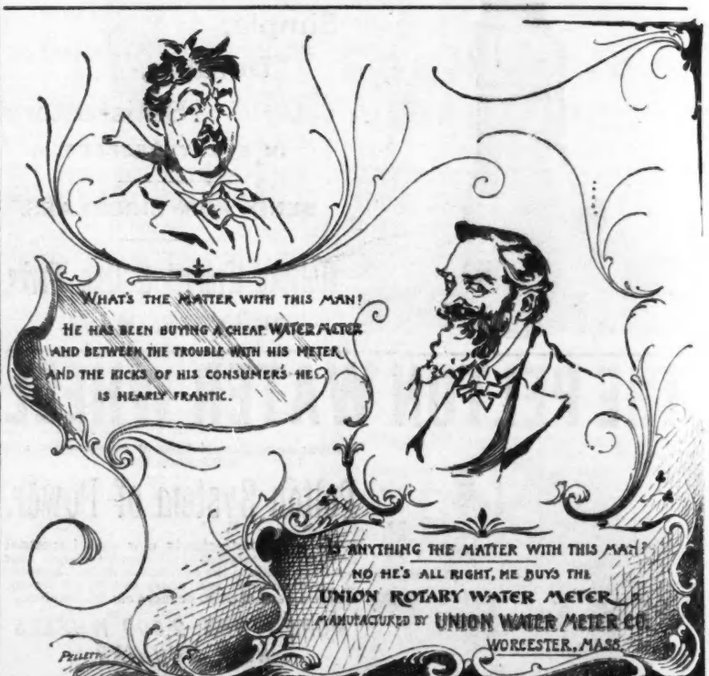
DUNHAM, CARRIGAN & HAYDEN CO., SAN FRANCISCO.

NEW ORLEANS RAILWAY & MILL SUPPLY CO. (Ltd.), NEW ORLEANS.

WATER METERS AND WATER-WORKS APPLIANCES

HERSEY M'F'G CO.,

SOUTH BOSTON, MASS.


WHAT'S THE MATTER WITH THIS MAN?
HE HAS BEEN BUYING A CHEAP WATER METER AND BETWEEN THE TROUBLE WITH HIS METER AND THE KICKS OF HIS CONSUMERS HE IS NEARLY FRANTIC.
IS ANYTHING THE MATTER WITH THIS MAN?
NO, HE'S ALL RIGHT, HE BUYS THE UNION ROTARY WATER METER
MANUFACTURED BY UNION WATER METER CO. WORCESTER, MASS.

H. F. COOK, Pres. & Treas. A. F. COOK, Vice Pres. N. E. COOK, Sec'y

THE COOK WELL CO.

General Office: 703 & 705 Market St. St. Louis, Mo. Chicago Office: 427 The Rookery

LARGEST WELL CONTRACTORS IN THE WORLD

LARGEST FACTORY IN THE WORLD Exclusively for the Manufacture of Well Material

Patentees of the Celebrated Cook's Well & Material

Cook's Artesian & Deep Well Pumps.

COOK'S NEW PATENT DOUBLE PISTON & DOUBLE ACTING WALKING BEAM POWER PUMP.

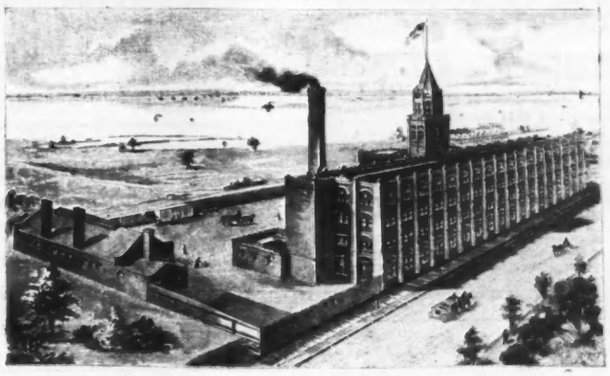
Double the Amount of Water Taken from Wells than by any other Pumping Rig.

COOK'S WELLS ADOPTED FOR SOURCE OF WATER SUPPLY BY NINETY THREE CITIES & TOWNS, TEN RAILWAY SYSTEMS, FIFTY THREE ICE FACTORIES, FORTY SEVEN DISTILLERIES & BREWERIES, TWENTY TWO PACKING HOUSES & HUNDREDS OF OTHER ENTERPRISES.

Twenty Three Years Experience in Contracting in all Parts of the World.

THE LEADING WATER METER MANUFACTURERS

OF THE WORLD.



OVER

107,000

METERS MADE AND SOLD TO DATE.

CROWN, EMPIRE, GEM AND NASH

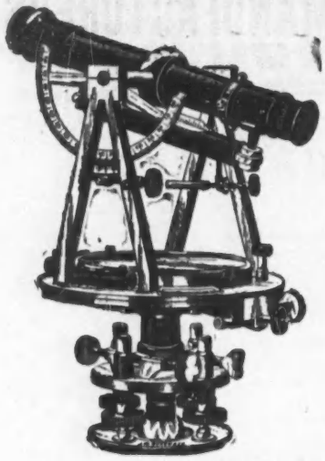
WATER METERS

NATIONAL METER COMPANY

287 BROADWAY, NEW YORK.

159 FRANKLIN STREET, BOSTON.

QUEEN & CO., PHILADELPHIA



MANUFACTURERS OF

Engineers', Surveyors' and Draftsmen's Supplies.

Improved Complete Engineers' Transi.

Power of telescope, 24 diam. Compound long centers. Two outside verniers. Five-in. needle. Level to telescope, vertical arc, clamp and tangent and the usual accessories. Complete with box and tripod. **PRICE, $180.**

ENGINEERS' PLAIN TRANSIT.

Same as above, without level, arc or clamp and tangent. **PRICE, $150.**

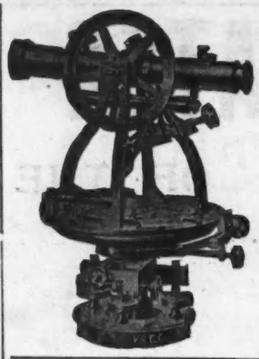
Improved Engineers' Wye Level.

Telescope, 18 or 20 in. Power, 40 or 50 diameters, as desired. Shifting center. Complete with box and tripod and usual accessories. **PRICE, $110.**

Any of these instruments sent on approval, with privilege to return if not satisfactory.

Catalogue on Application.

KEUFFEL & ESSER CO.,



LATEST AND MOST IMPROVED

TRANSITS, all kinds,

LEVELS, and other

FIELD INSTRUMENTS

—FOR—

ENGINEERS AND SURVEYORS.

Office Drawing Materials in Large Variety.

CATALOGUE ON APPLICATION

265 State St., Chicago. 127 Fulton St., New York.

BALL-BALL-CO.

FRANKFORD, PHILADELPHIA.

Manufacturers of Drawing Instruments.

Wholesale and Retail.

Send for Illustrated Catalogue just out. Mail Orders promptly filled.

MAHN & CO.,

212 Locust St., St. Louis, Mo.,

MANUFACTURERS OF

Surveying and Engineering Instruments.

ILLUSTRATED CATALOGUE ON APPLICATION.

CHARLES H. BRIGHTLY,

Late of HELLER & BRIGHTLY,

MANUFACTURER OF

Mathematical, Engineering and Surveying

INSTRUMENTS.

Germantown Junction, P. R. R. 16th St. Station, P. & R. R.

PHILADELPHIA, PA.

CHARLES S. HELLER (ESTABLISHED 1870.)

TRADING AS

HELLER & BRIGHTLY,

MANUFACTURERS OF

ENGINEERING, MINING AND SURVEYING

INSTRUMENTS,

Cor. SPRING GARDEN STREET and RIDGE AVENUE,

PHILADELPHIA, PA.

Surveyors' and Engineers

INSTRUMENTS & SUPPLIES.

T. F. RANDOLPH

81 W. 4th St., CINCINNATI O.

Established 1853. Send for Catalogue

BUFF & BERGER

9 PROVINCE COURT, BOSTON, MASS.

Manufacturers of all kinds of most improved

Surveying, Engineering and Astronomical Instruments.

Large Illustrated Catalogue and Manual of their Engineers and Surveyors' Field Instruments etc., on application.

ESTABLISHED 1820.

YOUNG & SONS,

MANUFACTURERS OF

ENGINEERING, MINING and SURVEYING INSTRUMENTS.

No. 43 N. 7th St., PHILADELPHIA

HERM. PFISTER

SUCCESSOR TO

R. WHITCOMB & CO.,

MANUFACTURER OF

Surveying and Engineering INSTRUMENTS.

195 W. 5th St., Cincinnati, O.

All kinds of Repairing promptly done

Diagrams, Formulas and Tables for Bridge Engineers and Architects. By Malverd A. Howe, Prof. C. E. at Rose Polytechnic Inst. Printed for private circulation only, but a few copies for sale by Engineering News Publishing Co., Tribune Building, New York, at 25 cents per copy. Easily worth four times the price.

FAUTH & CO., Manufacturers of

ENGINEERING INSTUMENTS.

Accuracy of graduation, powerful telescope, lightness with great strength, compact construction and first-class workmanship are the chief characteristics of our instruments. Send for catalogue describing the best **solar attachments** and **Vertical Sighting Arrangement** in use.

WASHINGTON, D. C.

W. & L. E. GURLEY.

Manufacturers of

Civil Engineers' and Surveyors

INSTRUMENTS.

Will send our Illustrated Price List of new improvements on application.

TROY, N. Y.

FROST & ADAMS,

Engineers, Surveyors AND Draughtsmen's Supplies.

37 CORNHILL BOSTON, MASS.

Tapes, Chains, Field Books, &c.

MAIL ORDERS PROMPTLY ATTENDED TO.

Send for Illustrated Catalogue.

IMPROVED

Engineering and Surveying

INSTRUMENTS.

MANUFACTURED BY

L. BECKMANN

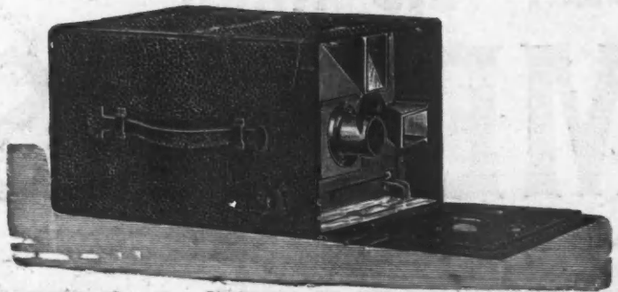
57 Adams Street

TOLEDO, OHIO.

First-class work at reasonable prices.

THE PREMIER CAMERA.

MODEL 1892.



Has several NEW and ATTRACTIVE FEATURES, still making it the BEST IN THE MARKET. GLASS PLATES, CUT FILMS or ROLL FILMS may be used. The change from one to the other can be made IN THE FIELD and in less than FIVE SECONDS.

Write for Premier Pamphlet and Copy of Modern Photography.

WE MAKE ALL KINDS OF CAMERAS.

ROCHESTER OPTICAL CO. ROCHESTER, N.Y.

THE TELEMANOMETER

for electrically indicating and recording pressure at a distance. Applicable to steam, gas or hydraulic machinery.

—MADE BY THE—

STANDARD THERMOMETER CO.,

PEABODY, MASS.

Send for Catalogue No. 20.

G. S. WOOLMAN, 116 Fulton St., N. Y.

TRANSITS, LEVELS, Full Field and Office Outfits, Etc., Etc.

Correspondence Solicited. Catalogues.

SURVEYING AND ENGINEERING INSTRUMENTS.

Transits, Levels, Compasses, Chains, Tapes, Drawing Instruments, Drawing Paper, Profile and Cross Section Paper Field Books, Squares, Triangles, Etc. Catalogue sent on application.

L. M. PRINCE,

134 W. FOURTH ST. CINCINNATI O.

HOWARD CARROLL, Pres. GEORGE C. CLAUSEN, Treas. C. S. CHAMBERLIN, Sec. HENRY BOLES, Gen. Man

THE SICILIAN ASPHALT PAVING CO.

THE NATURAL SICILIAN ROCK ASPHALT,

THE MOST DURABLE ASPHALT PAVEMENT IN THE WORLD.

Laid on 18 streets in New York, N. Y.
Laid on 22 streets in Montreal, Canada.
Laid on 9 streets in St. Augustine, Fla.
Laid on 7 streets in Rochester, N. Y.
Laid on 1 street in Philadelphia, Pa.
Laid on 4 streets, in Allegheny, Pa.
Laid on 66 streets in London, England
Laid on 57 streets in Berlin, Germany.
Laid on 13 streets in Paris, France.
Laid on 15 streets in Hanover, Germany.

Only Rock Asphalt Mastic manufactured in the United States. Made from Sicilian and German bituminous limestone rock.

SICILIAN ASPHALT PAVING CO. EAGLE BRAND TRADE MARK ROCK ASPHALT NEW YORK

Best Quality in the Market. Absolutely pure, containing no Sand or Coal Tar. Cheaper than any serviceable Imported Brand.

For Breweries, Ice Houses, Floors, Cellars, Stables, Yards, Sidewalks, Roofs, etc.

OFFICES: TIMES BUILDING, NEW YORK.

Agents for Rochester and District: THE ROCK ASPHALT PAVEMENT CO., 63 German Insurance Building, Rochester, N. Y. Agents for Dominion of Canada: THE SICILY ASPHALTUM PAVING CO., 10 to 14 Mill Street, Montreal.

DICKINSON BROS. & KING,

—IMPORTERS OF—

German and English Portland Cements.

Sole Agents for

K. B. & S. (English);
GERMANIA (German);
GLOBE (Belgian);
also
FRANCIS (English);
PHŒNIX (English);

21-24 STATE ST., NEW YORK.
36 Garondelet St., New Orleans. 127 Market St., Chicago.

GIANT PORTLAND CEMENT

Lesley & Trinkle
Successors to
J. Cambell, Harris & Co.
Dyckerhoff, Burham, Hilton's, Heyn Bros., Giant and Egypt Portland Cements.
Hudson River Rosendale Cements. Improved Union and Union Cement.
Fairmount Avenue Wharf, Phila., Pa.

FLOORS of Railroad Stations, Public Buildings, Stables, Cellars, &c.
ROOFS, CARRIAGEWAYS SIDEWALKS
LAID WITH
VAL DE TRAVERS —ROCK ASPHALTE.—
Durable, Fireproof and Impervious.
For estimates and list of Works executed apply to
The Neuchatel Asphalte Co., Ltd.,
265 BROADWAY, NEW YORK.
ROBERT BUTCHER MANAGER.

NEW YORK & BERMUDEZ CO.,
Sole Owners of the Largest Asphalt Lake in the World,
offer for sale the most superior quality of Asphalt for pavements, roofing, etc. It will do 50% more work than any other.
25 Beaver St., New York.

CALVIN TOMKINS
150 Broadway, - - New York.
Telephone No. 1063 Cortlandt.
TOMKINS COVE CRUSHED BLUE STONE FOR CONCRETE AND MACADAM.
Cement, Brick, Mortar Color, Plaster of Paris, Lime.

UNION AKRON CEMENT CO.,
Sole Manufacturers of the
AKRON CEMENT,
(Star Brand)
Warranted equal to any Hydraulic Cement manufactured in this country. Especially adapted for CONCRETE and use UNDER WATER. Capacity of works 1,500 barrels daily.
OFFICE, 141 ERIE St., BUFFALO, N. Y.

W. REID GOULD,
Legal and Commercial Stationer,
139 NASSAU ST., Beekman St., 120 BROADWAY, Arcade Equit. Bldg.,
NEW YORK.
Telephone Call. Cortlandt 1159.

DYCKERHOFF
PORTLAND CEMENT
is superior to any other Portland Cement made. *Circular with Testimonials and Tests sent on application.*
E. THIELE, 78 William St., N. Y., Sole Agent. U. S.

THE THAMES RIVER BRIDGE and Approaches at New London, Conn. Report by A. P. Boller, Chief Engineer. Half a dozen copies of this valuable report have been sent to us to dispose of; the Edition is nearing the end, and the present is the best time to secure a copy. Price $5. Address Engineering News.

Direct Black Print Paper
"PROGRESS."
BLACK LINES ON A WHITE GROUND.
This process does not require any developer like every other Positive Process.
It is as simple as the blue process, and requires only a water bath.
Manufactured ONLY by
SCHWENKE, KIRK & CO.,
Importers and Manufacturers of Drawing Materials,

STOW FLEXIBLE SHAFT CO. Limited

26th, Callowhill and Biddle Sts., Philadelphia, Pa.
Manufacturers of *Portable Drilling, Tapping, Reaming and Boring Machines.*
Also Tools for Emery Wheel Grinding, Metal and Wood Polishing. Cattle Brushing, and Clipping, etc.
General European Agents:
BOLLING & LOWE,

JAMES BRAND
81 Fulton St.,
NEW YORK.
P. O. Box 1098.
SOLE AGENT FOR
BURHAM (ENGLISH PORTLAND,)
FEWER (GERMAN PORTLAND.)
Importer of the following Cements:
Josson (Antwerp Portland.) | Keene's Superfine.
Lafarge French " | Keene's Coarse.

COMPAGNIE GENERALE
des ASPHALTES de FRANCE. 117 QUAI VALMY, PARIS.

SEYSSEL

Sole proprietors of the mines of Seyssel, Asphalte Mine Owners, also at Ragusa, etc
W. H. DELANO, Director; LEON MALE, Con. Eng.
Works in the United States: HUNTER'S POINT, L. I.

Architects and Engineers are requested to specify for Seyssel Rock Asphalte, for sidewalks, fireproof roofs, water-tight floors, sanitary cellars, etc.: also Compressed Rock Asphalte for roadways. For estimates apply to
N. Y. Mastic Works, 35 BOADWAY, N. Y

BUCKEYE Portland CEMENT BELLEFONTAINE, O.

Unequaled for all purposes for which Portland Cement is used. Tests and Testimonials of Engineers, and a Useful Pamphlet sent free on application.

BUCKEYE PORTLAND CEMENT CO.,
BELLEFONTAINE, OHIO.

FLEMING CEMENT & BRICK CO.,

23 LIBERTY STREET, NEW YORK,

—IMPORTERS OF—

BLACKCROSS BRAND

PORTLAND CEMENT.

Roman, Keene's, Lafarge, Vicat.

THE JUSTLY CELEBRATED

WEST VIRGINIA PAVING BRICK

IS THE BEST FOR STREETS AND ROADWAYS.

Not an experiment. In use nearly ten years.

Our brick have shown a crushing strength of 24,800 lbs. to the square inch. Used in 4 principal cities and towns throughout the country. Write for prices, samples, etc., to
Unequalled facilities for THE AMERICAN FIRE CLAY CO.
Shipping by Rail or Ohio River. Toronto, Jefferson Co., Ohio.

LOUISVILLE CEMENT

The undersigned is General Agent for the following Standard Brands of Louisville Cemen
Falls Mills (J. Hulme Brand). Black Diamond Mills (River).
Speed Mills. Falls City Mills. Queen City Mills. Acorn Mills.
Black Diamond Mills (Railroad).

This Cement has been in general use throughout the West and South since 1830; most of the public works having been constructed with it. Orders for shipments to any part of the country by rail or water, will receive prompt and careful attention. Sales for 1890, 1,533,579 barrels.

WESTERN CEMENT COMPANY, 247 W. Main St., Louisville, Ky

Utica Hydraulic Cement.

The undersigned are General Agents for the **James Clark** and **Black Ball Brands o. Utica Cement**, in general use throughout the West for the past 40 years—specially adapted for Sewer, Water and Gas Works. **Capacity, 800,000 Barrels per annum.** Used exclusively for the past 20 years in the Construction of over **800 miles of Sewers** in Chicago, and by the several Gas Companies of the same city. Warranted equal to any Hydraulic cement manufactured in this country. Orders will receive prompt and careful attention.

MEACHAM & WRIGHT, Gen'l Ag'ts, 98 Market St., Chicago, Ill

ASPHALT PAVING BLOCKS AND TILES.

For Streets, Sidewalks, Gutters, Railway Stations, Stables, Cellars, Breweries, Arsenals, Etc.

MATERIALS.—Crushed Limestone and Trinidad Asphaltum, subjected to a pressure of 3,000 pounds to the square inch at 250° (Fahrenheit).

Noiseless, non-absorben and less costly than stone or any other durable pavement.

Subjected to 10 years' trial. In 1889 over 5,000,000 of these blocks and tiles were laid in Washington, Baltimore, Philadelphia, Camden Trenton, New York, Chicago, etc. In 1891 over 8,000,000 of these blocks were laid in the United States, Mexico and South America. Manufactured by THE HASTINGS PAVEMENT CO., 140 Pearl St., New York, N. Y.

H. A. WARNER NEW HAVEN CONN.
OHIO SEWER PIPE
WRITE FOR PRICES
Low Rates to Dealers Officials, Contractors.

THE SABULA DRAW BY GRAPHICS. A practical illustration of the Application of Graphics and Comparison with Analytical Methods. By Prof. Malverd A. Howe, C. E. Price $1. For sale by Engineering News Publishing

STOW FLEXIBLE SHAFT

Invented and Manufactured by the
Stow Manufacturing Co.,
BINGHAMTON, N. Y.
Established 1857.
For tapping and reaming stay bolt Holes in
BOILERS.

R. D. WOOD & CO.

Engineers, Iron Founders, Machinists.

400 CHESTNUT STREET, PHILADELPHIA, PA.

CONSTRUCTORS OF GAS AND WATER WORKS.

MANUFACTURERS OF ALL KINDS AND SIZES OF CAST IRON PIPE.

FREEMAN'S VALVE INDICATOR POSTS. EDDY VALVES, LAMP POSTS, ETC. GAS HOLDERS AND GAS MACHINERY.

HYDRAULIC CRANES, PRESSES, LIFTS, ETC. TURBINES AND WATER POWER PUMPS. HYDRAULIC TRAVELING CRANES.

Foundries and Wks. at: MILLVILLE, N. J. FLORENCE, " CAMDEN, "

MATHEWS' SINGLE AND DOUBLE VALVE FIRE HYDRANTS.

CHEMICAL AND SUGAR HOUSE WORK, LOAM CASTINGS. HEAVY SPECIAL MACHINERY, GENERAL CASTINGS.

THE Q AND C CO. CHICAGO AND NEW YORK. The Q and C Co. Chicago & New York. THE Q AND C CO. CHICAGO AND NEW YORK.

SERVIS TIE PLATES

WARREN'S ANCHOR BRAND

TRADE MARK

Asphalt Paint

THE CHEAPEST AND MOST DURABLE PAINT

—FOR—

BRIDGES, METAL ROOFS and ALL EXPOSED METAL AND ROUGH WOODWORK.

Also Warren's Anchor Brand Asphalt Roofing and Paving Materials

Warren Chemical & Manufacturing Co.,

81 and 83 FULTON ST., NEW YORK.

Send for Circulars and Samples.

CAMERON STEAM PUMP

SIMPLE, RELIABLE, COMPACT, DURABLE.

NO OUTSIDE VALVE GEAR.

ADAPTED FOR ALL PURPOSES.

THE A·S·CAMERON STEAM PUMP WORKS

FOOT OF EAST 23d STREET, NEW YORK.

ALUMINUM.

THE PITTSBURGH REDUCTION COMPANY, 116 Water St., Pittsburgh, Pa.

Offer Aluminum guaranteed equal in purity to the best in the market at lowest rates obtainable.

ALUMINUM SHEET, WIRE AND CASTINGS.

CABLE RAILWAYS.

E. SAXTON,

CONTRACTOR,

WASHINGTON, D. C.

CABLE RAILWAYS BUILT BY E. SAXTON:

Grand Avenue and 15th Street Line, for Grand Avenue Railway Co., Kansas City, Mo.
Grand Avenue and Westport Line, for Grand Avenue Railway Co., Kansas City, Mo.
Holmes Street Line, for Holmes Street Railway Co., Kansas City, Mo.
"The Loop Line," for Metropolitan Railway Co., Kansas City, Mo.
Seventh Street Line, for Washington & Georgetown R. R. Co., Washington, D. C.
Eleventh and Thirteenth Sts. Line, for Tacoma R'y & Motor Co., Tacoma, State of Washington
Navy Yard and Georgetown Line, for Washington & Georgetown R. R. Co., Washington, D. C.
Fourteenth Street Line, for Washington & Georgetown R. R. Co., Washington, D. C.

NOW BUILDING:

Blue Line of the Baltimore City Passenger R. R. Co.

BALTIMORE OFFICE, COR. BIDDLE AND CATHEDRAL STREETS.

TRAUTWINE'S POCKET BOOK.

"The most useful hand book in the language in the engineering profession."—*Engineering and Mining Journal*, Aug. 25, 1888.

PATENTED.

WAKEFIELD TRIPLE LAP SHEET PILING

A PILE MADE OF THREE EQUAL WIDTH PLANKS BOLTED TOGETHER.

SIMPLEST. CHEAPEST. BEST.

Easy to make and made any length. Perfectly matched; stands the heaviest pounding.

NEVER FAILS TO GIVE SATISFACTION.

Don't use old make-shift Sheetings for Dams, Coffer Dams, Docks, Levees or any place where you want to stop water.

USE THE WAKEFIELD.

PATENTED IN THE U. S. AND CANADA.

Address, for Catalogue and information.

WAKEFIELD SHEET PILING CO.,

445 ROOKERY, CHICAGO, ILL.

BUILDERS' IRON FOUNDRY

PROVIDENCE, R. I.

Globe Specials for Water-Works.

ADOPTED BY MORE THAN 225 TOWNS AND CITIES.

M. J. DRUMMOND, Sales Agent, 192 Broadway, N. Y. City.

TABLES OF SQUARES, containing the square of every foot, inch and sixteenth of an inch between one-sixteenth of an inch and 50 ft. Invaluable for engineers and calculators. By E. F. Buchanan, C. E. 100 pages.. 1890. Price $2. For sale by Engineering News Publishing Co., Tribune Building, New York City.

RAILROAD TERMINALS AND TRAIN shed.—This article describes and illustrates the largest trainshed, and the well arranged yards of the Penna. R. R., at Jersey City. The shed is 652 ft. 6 ins. long by 256 ft. wide, and 98 ft. high; it is one of the finest railway structures in the world, and worth the study of every engineer and architect interested in such work. Published in ENGINEERING NEWS, Sept. 20, 1890. Price, 15 cents.

Proposals for Dredging and Excavating.

SANITARY DISTRICT OF CHICAGO.

TO CONTRACTORS.

Sealed proposals addressed to the Board of Trustees of the Sanitary District of Chicago and indorsed:

"Proposals for excavating the main drainage channel" will be received by the Clerk of said Sanitary District at Room H, Rialto building, Chicago, Ill., until 12 m. (standard time) of Wednesday the 25th day of January, 1893, and will be publicly opened by the said Board of Trustees at the regular meeting held that day, or at a special meeting called for that purpose.

THE WORK FOR WHICH THE SAID TENDERS ARE INVITED IS THE EXCAVATION OF SECTIONS A, B, C AND E OF THE MAIN DRAINAGE CHANNEL FOR THE SAID SANITARY DISTRICT BETWEEN WILLOW SPRINGS AND SUMMIT, ILL., AND THE DREDGING OF THE ILLINOIS AND MICHIGAN CANAL BETWEEN SUMMIT AND THE SOUTH FORK OF THE CHICAGO RIVER. Said work will consist in all of the excavation of about 7,200,000 cubic yards of earth, of about 95,000 cubic yards of rock, the building of 30,000 cubic yards of retaining walls, and the dredging of about 1,800,000 cubic yards of earth from that portion of the main channel comprised in the Illinois and Michigan canal between Summit and the south fork of the Chicago river.

Said work is divided into sections (the dredging of the Illinois and Michigan canal being one section), each of which will be treated as a separate contract in canvassing the proposals and making awards. As all awards will be made by individual sections as provided in the specifications and forms of proposals to be furnished bidders, each bidder must make price for each section separate and distinct from every other. The lumping of prices in any bid will render such bid informal and will cause its rejection by the said board of trustees.

Each proposal must be accompanied by a certified check or cash to an amount equal to $3,000 multiplied by the number of sections bid upon.

All certified checks must be drawn on some responsible bank doing business in the city of Chicago and be made payable to the order of the Clerk of the Sanitary District of Chicago. Said amount of $3,000 for each section will be held by the Sanitary District until all of said proposals have been canvassed and contracts awarded and signed, the return of said check or cash being conditioned upon any bidder to whom an award of any portion of said work may be made appearing within ten days after notice of such award being given, with bondsmen, and executing a contract with the Sanitary District for the section or sections of said work so awarded and giving a bond satisfactory to the said board of trustees for the fulfillment of the same in the amount of $75,000 for each section of work awarded him.

All proposals must be made upon blank forms furnished by the Sanitary District and must give the price for each separate item of work.

The bids will be compared on the basis of the Engineer's approximate estimate of quantities which will be furnished with copies of the specifications.

No proposal will be considered unless the party making it shall furnish evidence satisfactory to the Board of Trustees of his ability to do the work and that he has the necessary pecuniary resources to fulfill the conditions of the contract, provided such contract shall be awarded him.

Bidders are required to state in their proposals their individual names and places of residence in full.

Specifications and plans may be seen at the office of the chief engineer, Room D, Rialto building, Chicago, Ill.

The said Board of Trustees reserves the right to reject any and all bids.

THE SANITARY DISTRICT OF CHICAGO,
By FRANK WENTER, President.
Attest: THOMAS F. JUDGE, Clerk.
Chicago, Nov. 25, 1892. 49-8t

UNITED STATES ENGINEER OFFICE, Detroit, Mich., December 13, 1892.—Sealed proposals for furnishing all labor, materials and appliances, and constructing the floors, etc., of the 800-ft. lock at St. Mary's Falls Canal, Mich., will be received at this office until 2 p. m., standard time, January 12, 1893, and then publicly opened. Specifications, blank forms, and all available information will be furnished on application to this office. O. M. POE, Colonel, Corps of Engineers, Brt. Brig.-Gen., U. S. A. 51-3t

UTICA PIPE FOUNDRY CO.
CAST IRON PIPE AND SPECIALS FOR WATER AND GAS.
Also flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, etc. CHAS. MILLAR & SON, Selling Agents, Utica, N. Y. Manufacturers of Lead Pipe and Plumbers' Materials. Wholesale Eastern Agents Akron Vitrified Sewer Pipe.

MONTAGUE & COMPANY,
MANUFACTURERS
FIRE BRICK, SEWER PIPE,
DOUBLE STRENGTH
RAILROAD CULVERT PIPE.
CHATTANOOGA, TENN.

JOHN W. HARRISON, Pres. and Treas. THOS. HOWARD, Vice-Pres.
F. B. NICHOLS, 2d Vice-Pres. E. H. QUEEN, Sec'y. P. MCARTHUR, Supt.
HOWARD-HARRISON IRON COMPANY,
MANUFACTURERS OF
CAST IRON PIPE
FOR WATER-WORKS, GAS WORKS, CULVERTS.
Pipe and Pump Connections. Flexible Joints. Heavy Loam Castings.
Works at BESSEMER, ALA. Offices at BESSEMER and ST. LOUIS.

ARTHUR KIRK & SON, PITTSBURGH, PA.
POWDER, DYNAMITE, ROCK DRILLS,
AIR COMPRESSORS, ROCK BREAKERS,
Safety Fuse, Electric Batteries, Miners' Squibs.

FOR Best Results USE THE WARREN FILTER,
—MANUFACTURED BY—
CUMBERLAND MFG. CO., Boston, Mass.

TREASURY DEPARTMENT, OFFICE Supervising Architect, Washington, D. C., December 14th, 1892.—Sealed proposals will be received at this office until 2 o'clock p. m., on the 17th day of January, 1893, and opened immediately thereafter, for all the labor and materials required to put in place complete the cast iron and Z-bar columns, steel and iron floor, ceiling and roof construction, ceiling light, skylight roof, dormers, etc., complete, for the U. S. Post Office building, Worcester, Massachusetts, in strict accordance with the drawings and specification, copies of which may be had on application at this office, or the office of the Superintendent at Worcester, Massachusetts. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any and all bids, and to waive any defect or informality in any bid, should it be deemed in the interest of the Government to do so. All bids received after the time stated will be returned to the bidders. Proposals must be inclosed in envelopes, sealed and marked, "Proposal for Iron Columns, Steel and Iron Floor, Ceiling and Roof Construction, etc., for the U. S. Post Office Building, Worcester, Mass," and addressed to W. J. EDBROOKE, Supervising Architect. 52-2t

U. S. ENGINEER OFFICE, NEWPORT, R. I., November 24, 1892.—Sealed proposals, in triplicate, for stone work at Block Island, R. I., and Nantucket and Vineyard Haven, Mass., will be received at this office until 12 m., noon, on the 9th day of January, 1893, and then opened. The attention of bidders is invited to the Acts of Congress approved February 26, 1885, and February 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large, and the Act of August 1, 1892, Sections 1 and 2 (Public No. 193). The United States reserves the right to reject any or all proposals and to waive any informalities. Full information furnished on application. W. H. BIXBY, Captain, Corps of Engineers U. S. Army. 50-4t

TREASURY DEPARTMENT, OFFICE OF the Supervising Architect, Washington, D. C., December 14th, 1892.—Sealed proposals will be received at this office until 2 o'clock p. m., on the 12th day of January, 1893, and opened immediately thereafter, for all the labor and materials required for the excavation, foundations, basement and area walls, basement columns and first floor construction for the U. S. Post Office building at Columbus, Ga., in accordance with the drawings and specification, copies of which may be had on application at this office or the office of the Superintendent at Columbus, Ga. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any and all bids or to waive any defect or informality in any bid. If it be deemed in the interest of the Government to do so. All proposals received after the time stated will be returned to the bidders. Proposals must be inclosed in envelopes sealed and marked, "Proposal for Excavation, Foundations, Basement and Area Walls, Basement Columns, and First Floor Construction for the U. S. Post Office Building at Columbus, Ga.," and addressed to W. J. EDBROOKE, Supervising Architect. 52-2t

NOTICE TO TUNNEL ENGINEERS.
Office of the Board of Public Works,
City of Duluth, Minn., November 15, 1892.

Competitive plans for a combined tunnel under the Duluth ship canal, for the accommodation of steam railway, street railway, wagon and foot travel, will be received by the Board of Public Works, in and for the corporation of the City of Duluth, until 10 a. m., on the 2d day of January, 1893.

Data and specifications in relation thereto are on file in the office of said Board, or will be furnished upon application to the undersigned. A cash prize of $1,000 will be paid for the best plans submitted. The principal features of the plans submitted, which will be considered above all others, will be cheapness of construction, durability, and adaptability to location.

HENRY TRUELSEN,
President Board of Public Works.
Attest.: T. W. ABELL,
Clerk. 48-6t

U. S. ENGINEER OFFICE, NEWPORT, R. I., November 24, 1892.—Sealed proposals, in triplicate, for dredging in Pawtucket and Providence Rivers, R. I., and Green Jacket Shoal, Providence Harbor, R. I., will be received at this office until 1 p. m., on the 9th day of January, 1893, and then opened. The attention of bidders is invited to the Acts of Congress approved February 26, 1885, and February 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large, and the Act of August 1, 1892, Sections 1 and 2, (Public No. 193). The United States reserves the right to reject any or all proposals and to waive any informalities. Full information furnished on application. W. H. BIXBY, Captain, Corps of Engineers, U. S. Army. 50-4t

PROPOSALS FOR SUPPLIES FOR THE Navy Yard, Washington, D. C.—December 14, 1892.—Sealed proposals, indorsed, "Proposals for Supplies for the Navy Yard, Washington, D. C., to Be Opened January 3, 1893," will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock, noon, January 3, 1893, and publicly opened immediately thereafter, to furnish at the Navy Yard, Washington, D. C., a quantity of pipe and pipe fittings, tools, packing, hose, and steel plates; and at the Naval Proving Ground, Indian Head, Md., a quantity of bricks, cement, lime, window frames, hardware, lumber, roofing tin, sheet iron, and sheathing copper. The articles must conform to the Navy standard and pass the usual naval inspection. Blank proposals will be furnished upon application to the Navy Yard, Washington, D. C., or to the Bureau. The attention of manufacturers and dealers is invited. Tie bids, all other things being equal, decided by lot. The Department reserves the right to waive defects or to reject any or all bids not deemed advantageous to the Government. EDWIN STEWART, Paymaster General, U. S. N.

TREASURY DEPARTMENT, OFFICE OF the Supervising Architect, Washington, D. C., December 14th, 1892.—Sealed proposals will be received at this office until 2 o'clock p. m., on the 17th day of January, 1893, and opened immediately thereafter, for furnishing all the labor and materials, and fixing in place complete, the low pressure, return circulation, steam heating and ventilating apparatus required for the U. S. Court House, Post Office and Custom House building at Bay City, Michigan, in accordance with the drawings and specification, copies of which may be had at this office or the office of the Superintendent, at Bay City, Michigan. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any and all bids, or to waive any defect or informality in any bid if it be deemed in the interest of the Government to do so. All proposals received after the time stated will be returned to the bidders. Proposals must be inclosed in envelopes, sealed and marked "Proposal for a Low Pressure, Return Circulation, Steam Heating and Ventilating Apparatus for the U. S. Court House, Post Office, and Custom House Building, at Bay City, Michigan," and addressed to W. J. EDBROOKE, Supervising Architect. 52-2t

Pumping Machinery.

OSAKA, JAPAN, WATER-WORKS.

Tenders are invited for supplying three sets of centrifugal pumps, five sets of double acting main pumps, boilers, and other accessories required in the Osaka Water-Works, Osaka, Japan.

Parties tendering shall only be a person or a firm who has the following qualifications:

They have the manufactory at the time of tendering; have engaged in the manufacture of pumping machinery over five years; and have supplied more than five sets of the pumping engines of a kind similar to those referred to in the specifications.

The printed copies of general rules for supplying of the goods, a proposed form of contract, their specifications and drawings may be inspected and obtained at H. I. Japanese M'a Consulate, at No. 7 Warren St., New York City.

The space of time to be taken before entering the contract after the close of tendering is supposed to be about 5 months, during which parties tendering have to appoint their representative in Japan (whether Japanese or foreigner, residing in Japan, and inform the Osaka Shi Sanji Kwai (the Osaka City Council), the name of the representative at earliest convenience.

The space of time to be allowed for manufacturing and conveying them to Kobe, Japan, after signing of the contract, shall be 12 months.

Sealed tenders, addressed to the Osaka Shi Sanji Kwai, are to be forwarded to the undersigned before and on the 28th of February, 1893, after which no tender will be received. KUMASABRO TANABE,

Chancellor in charge of the Japanese Consulate General, No. 7 Warren St.

51-4t-eow

World's Fair Route.

The Cincinnati, Hamilton & Dayton R. R. is the only line running Pullman's Perfected Safety Vestibuled Trains, with Chair, Parlor, Sleeping and Dining Car Service, between Cincinnati, Indianapolis and Chicago, and is the Only Line running Through Reclining Chair Cars between Cincinnati, Keokuk and Springfield, Ill. It is the popular line between Cincinnati and St. Louis with Through Sleeping Cars on Night Trains and Chair Cars on Day Trains, and the Only Direct Line between Cincinnati, Dayton, Lima, Toledo, Detroit, the Lake Regions and Canada.

Tickets on sale everywhere, and see that they read C., H. & D., either in or out of Cincinnati, Indianapolis, or Toledo. E. O. McCORMICK, General Passenger and Ticket Agent, Cincinnati, O. 51-20t-eow

TREASURY DEPARTMENT, OFFICE Supervising Architect, Washington, D. C., December 20, 1892.—Sealed proposals will be received at this office until 2 o'clock p. m. on the 18th day of January, 1893, and opened immediately thereafter for all the labor and material required to furnish and erect complete, either a hydraulic passenger elevator, or a steam passenger elevator in lieu of a hydraulic elevator; and also one direct acting hydraulic freight lift or a steam lift in lieu of same, required for the new elevator plant for the U. S. Court House and Post Office Building at Denver, Colorado, in accordance with the drawings and specification, copies of which may be had on application at this office or the office of the Superintendent, at Denver, Colorado. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any or all bids, and to waive any defect or informality in any bid, should it be deemed in the interest of the Government to do so. Proposals must be inclosed in envelopes, sealed and marked "Proposal for Furnishing and Erecting Complete One Passenger Elevator, and One Freight Lift in the U. S. Court House and Post Office Building, at Denver, Colorado," and addressed to W. J.

Sewage Disposal Works Machinery.

NOTICE TO CONTRACTORS.

Sealed bids will be received at the office of the City Clerk of the City of Canton, Ohio, until 12 o'clock noon, of Monday, January 23, 1893, for furnishing machinery and appurtenances for the purification of 2,000,000 gallons per day of house sewage. Said machinery to be located in the building now being erected, and purification effected by chemical precipitation through masonry tanks now built at the disposal works of the City of Canton. Bids will be received for the following machinery:—

1st—One low service sludge pump of capacity of 150 gallons per minute, lifted a maximum height of 32 ft.

2d—One high service sludge and water pump, equivalent in capacity to a 7½ × 5 × 10 duplex plunger pump against 120 lbs.' pressure, and at 80 ft. piston speed.

3d—Two chemical mixing chambers with power and appurtenances.

4th—One tubular boiler, 54 ins. by 12 ft., with setting and piping complete.

5th—One improved filter press complete.

6th—All pipes, appurtenances and fittings complete for the before mentioned machinery, and everything necessary to complete and place in working order each of the above machines.

7th—For all machinery and appurtenances, after designs and plans of the bidder, for the purification and clarification, chemical precipitation of 2,000,000 gallons of house sewage per day, all located in the city disposal building and effected through the precipitation tanks now built, all in accordance with general specifications and plans on file in the office of the City Civil Engineer of said city.

Each proposal shall be signed by all persons interested in same, and must be accompanied by a certified check in the following amounts: For the low service pump, $100; for the high service pump, $150; for the chemical mixing chamber, $200; for the boiler complete, $200; for the filter press, $200; or for the plant complete, $850, as a guarantee for the execution of the contract, in case the bid is accepted. Specifications may be had of the undersigned on or after January 5, 1893.

Bids must be made on blank forms, which will be furnished by the City Civil Engineer, upon application.

The City Council reserves the right to reject any or all bids.

WM. LICHTENWALTER, City Clerk.
L. E. CHAPIN, Civil Engineer. 53-4t

TO MASONRY CONTRACTORS.

Proposals will be received at the office of the Lexington Water-Works Company, in Lexington, Ky., until Wednesday, March 1st, 1893, at 3 o'clock p. m., for the construction of an additional dam and waste weir for the purpose of enlarging the present reservoir.

Plans and specifications can be seen at the office of the company, No. 8½ East Main street, Lexington, Ky.

The right is reserved to reject any or all bids. S. A. CHARLES,
Superintendent and Engineer in Charge.
53-9t

Edinburgh, Ind., Water-Works.

Sealed proposals will be received until noon, Monday, January 23, 1893, by the President and Board of Trustees of the town of Edinburgh, Indiana, for the material and labor, together and separately, required to construct a system of water-works. Each bid must be accompanied by a certified check to the amount of $100, as a guarantee of good faith. The right to reject any or all bids reserved. Plans and specifications can be seen at the office of Town of Edinburgh, Indiana; also at office of Consulting Engineer, John J. Hainsworth, Franklin, Indiana. M. DUCKWORTH,
Pres. Board of Trustees. 53-4t

Notice to Fire Hose Manufacturers.

Sealed proposals will be received by the undersigned at his office until Monday evening, Jan. 2, 1893, for 1,000 ft. 2½-in. fire hose with couplings (cotton hose); bidders will submit samples of hose. Hose to be paid for one year from date of purchase.

Councils reserve the right to reject any or all bids. JAS. A. LINDSEY,
City Clerk.
Bradford, Pa., Dec. 20, 1892. 52-2t

For other proposals see page XII.

NOTICE TO CONTRACTORS.

Sealed proposals will be received at the office of J. F. Barrett, City Clerk of the City of Sterling, Illinois, up to six o'clock p. m. of Monday, Jan. 16, 1893, for furnishing materials and doing the work of paving Third St. in said City of Sterling from Third Ave. to B Ave. The work will comprise approximately the following:

12,812 sq. yds. brick paving (more or less).
4,400 lin. ft. of curbing (more or less).
750 cu. yds. stone retaining walls (more or less).

The whole of the work to be completed on or before July 1, 1893.

Specifications and blank forms for bids can be obtained upon application to J. F. Barrett, City Clerk, and plans may be seen at the office of W. P. Palmer, Supt. of Streets.

Each bid must be accompanied by a certified check for the sum of five hundred dollars, payable to the order of Hon. A. H. Hershey, Mayor, which check will be forfeited to the City of Sterling in the event that any bidder or bidders shall fail to execute properly a contract, with good and sufficient sureties, if awarded the contract; otherwise to be returned to the bidder. Payment for the work will be made partly in scrip, bearing six per cent. interest.

The bids will be opened and read publicly at the meeting of the City Council at 7:30 o'clock p. m., Jan. 16, 1893, and the Council reserves the right to reject any or all bids for any reason it may deem sufficient.

By order of the City Council of the City of Sterling, Illinois.

JAMES F. PLATT,
Chairman Streets and Alleys Com.
Sterling, Ill., Dec. 14, 1892. 52-2t

CURTIS STEAM AND GREASE SEPARATOR

SCIENTIFIC IMPROVEMENTS.

It is one thing to separate the water from the steam by surface interposed in the current, and quite another to shape that surface so as to deflect the water so separated that it is prevented from getting back into the current.

We have accomplished both.

Scientific tests prove it.

For separating grease and sediment from exhaust steam, the action of the separator is perfect. A grease cock is placed just below the water line, and the grease, which is lighter than water, drawn off at intervals, while the water flows through the trap, and the sediment, which is heavier than the water, settles to the bottom and can be removed at pleasure by taking off the cover which removes the float and exposes the interior for inspection.

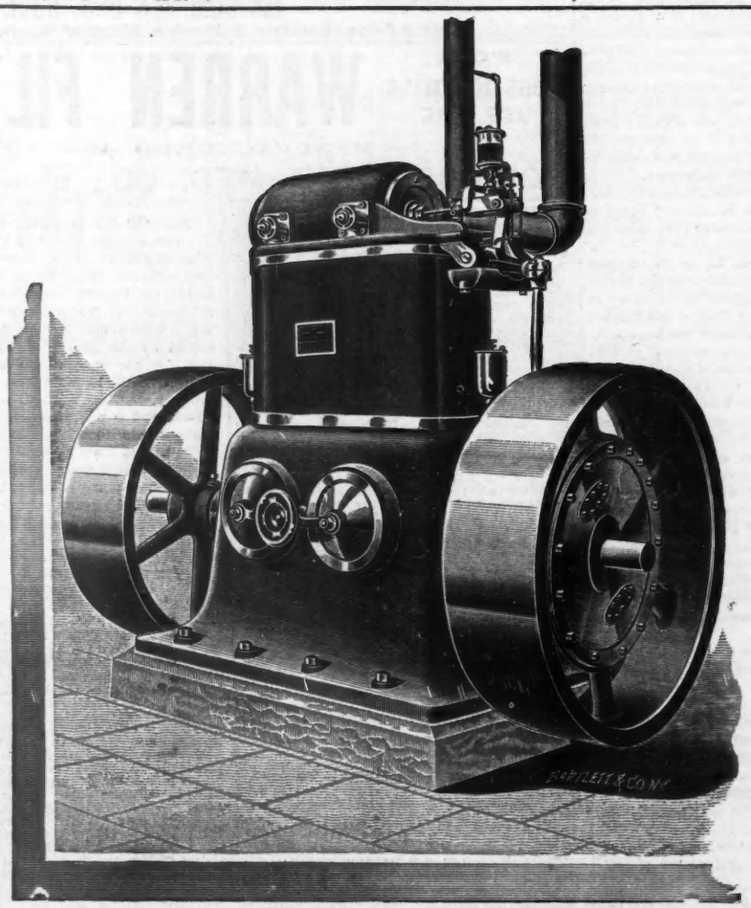
OUR PATENTS.

Damper Regulators, Pressure Regulators for Steam and Water, Return Traps, Separators, Balanced Steam Traps, Damper Regulators for Hot Water Heating other Steam Specialties.

GENERAL AGENCIES:

NEW YORK, 109 Liberty Street.
PHILADELPHIA, 2035 N. Front Street.
CHICAGO, 218 Lake Street.
DENVER, 1622 Arraphoe Street.

THE CURTIS REGULATOR CO., 29, 31, 33 HAVERHILL STREET, BOSTON, MASS.



H. H. WESTINGHOUSE. WM. LEE CHURCH. WALTER C. KERR. ISAAC H. DAVIS

WESTINGHOUSE, CHURCH, KERR & CO., ENGINEERS.

NEW YORK, 17 Cortlandt Street. CHICAGO, 156 and 158 Lake Street. BOSTON, 620 Atlantic Avenue.
ST. LOUIS, Commercial Building. PITTSBURG, Westinghouse Building. MINNEAPOLIS, Beery Block.
Represented in PHILADELPHIA by M. R. MUCKLE, Jr., & Co., Drexel Building.

WESTINGHOUSE ENGINES.

THE COMPOUND AUTOMATIC ENGINE.
The only Engine ever built which will give practically Uniform Economy under Widely Variable Loads, whether Condensing or Non-condensing.

THE STANDARD AUTOMATIC ENGINE.

THE JUNIOR AUTOMATIC ENGINE.

THE RONEY MECHANICAL STOKER AND SMOKELESS FURNACE.

COAL AND ASH HANDLING MACHINERY FOR LARGE PLANTS

THE STEAM LOOP. For Separating and Returning Condensation and Primage.

Classified Directory of Current Advertisements.

Air Compressors.
Arthur Kirk & Son, Pittsburg, Pa.
Clayton Air Compressor Works, N. Y.
Deane Steam Pump Co., Holyoke, Mass.
Ingersoll-Sergeant Rock Drill Co., N. Y.
Norwalk Iron Works Co., So. Norwalk, Conn.
Rand Drill Co., 23 Park Place, New York.
Thomas Carlin's Sons, Allegheny, Pa.

Air Brakes.
American Brake Co., 160 Broadway, N. Y.
Westinghouse Air Brake Co., Pittsburg, Pa.

Aluminum.
Pittsburg Reduction Co., 95 Fifth Ave., Pittsburg, Pa.

Analysis (Water and Commercial).
Hunt & Clapp, Pittsburg, Pa.

Architects.
Gilbert, Bradford L., New York City.
Howell, D. J., Washington, D. C.
Wilson Bros. & Co., Drexel Bldg., Phila., Pa.

Artesian Well Machinery.
American Well Works, Aurora, Ill.
Oil Well Supply Co., N. Y. and Pittsburg.
The Cook Well Co., St. Louis, Mo.

Asphalt Paving.
N. Y. & Bermudez Co., 55 Beaver St., N. Y.
Thiele, E., 78 William St., City.
N. Y. Mastic Co., New York.

Automatic Register.
Osborn & Co., G. Edw., New Haven, Conn.

Automatic Steam Engine.
Shipman Engine Co., Boston, Mass.

Belt Dressing.
Jos. Dixon Crucible Co., Jersey City, N. J.

Black Print Paper.
Schwenke, Kirk & Co., N. Y. City.

Blocks (Tackle).
Boston & Lockport Block Co., Boston, Mass.

Boilers.
Abendroth & Root Mfg. Co., New York.
Babcock & Wilcox Co., New York.
Carlin's Sons, Thos., Allegheny, Pa.
Carlisle Mfg. Co., Carlisle, Pa.
Fairbanks, Morse & Co., Chicago.
Forsaith, S. C. & Co., Manchester, N. H.
Hodge C. Co., E., East Boston, Mass.
Iredell, F. W., 10 Park Place, New York.
Lidgerwood Mfg. Co., 96 Liberty St., N. Y.
Mundy, J. S., Newark, N. J.
Oil Well & Supply Co., 82 Fulton St., N. Y.
Pancoast & Rogers, New York.
Porter Mfg. Co., Limited, Syracuse, N. Y.
Riter & Conley, Pittsburg, Pa.
Robert Poole & Son Co., Baltimore, Md.
Ryan-McDonald Mfg. Co., Baltimore, Md.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Tippett & Wood, Phillipsburg, N. J.

Brake Shoes.
Congdon Brake Shoe Co., Chicago, Ill.

Brick and Tile.
American Fire Clay Co., Toronto, O.
Freeman Fire Clay Co., Freeman, O.
Moffett, Hodgkins & Clarke, Syracuse, N.Y.
Ohio Sewer Pipe Co., Pittsburg, Pa.
Ohio Paving Co., Columbus, O.
Park Fire Clay Co., Pittsburg, Pa.
Sharon Clay Mfg. Co., Sharon, Pa.
Staten Island Terra Cotta Lumber Co., New York City.
Tomkins, Calvin, 130 Broadway, N. Y.
United States Fire Clay Co., Pittsburg, Pa.

Brick and Tile Machinery.
Carlin's Sons, Thomas, Allegheny, Pa.

Bridges, Viaducts, Buildings and Roofs.
Binder & Seifert, Chicago, Ill.
Boston Bridge Works, Boston, Mass.
Bouscaren, G., Cincinnati, O.
Champion Bridge Co., Wilmington, O.
Chicago Bridge and Iron Co., Chicago.
Cofrode & Evans, Pottstown, Pa.
Cooper, Theodore, 35 Broadway, N. Y.
Edge Moor Bridge Works, Edgemoor, Del.
Elmira Bridge Co., Elmira, and New York.
Frescoln, Samuel Wilson, World Bdg., N. Y.
Groton Bridge & Mfg. Co., Groton, N. Y.
Kandeler, Theo., Chicago Ill.
King Bridge Co., Cleveland, O
Livingood, W. C., Philadelphia, Pa.
Lowe th, Chas. F., 560 Drake Bldg., St Paul, Minn.
Massillon Bridge Co., Massillon, O.
McCain, F. J. & Bro., Chicago, Ill.
Mo. Valley Bridge & Iron Works, Leavenworth, Kan.
Mt. Vernon Bridge Co., Mt. Vernon, O.
Ottewell, Alfred D., San Francisco, Cal.
Passaic Rolling Mill Co., Paterson, N. J.
Pennsylvania Steel Co., Steelton, Pa.
Pittsburg Bridge Co., Chicago.
Pencoyd Bridge and Construction Co., Pencoyd, Pa.
Philadelphia Bridge Works, Phila., Pa.
Phœnixville B'dge Works, Phœnixville, Pa.
Pottsville Iron & Steel Co., Pottsville, Pa.
Riter & Conley, Pittsburg, Pa.
Rochester Bridge & Iron Works, Rochester, N. Y.
San Francisco Bridge Co., San Francisco, Cal.
Schultz Bridge & Iron Co., Pittsburg, Pa.
Shaller & Schmiglan, Chicago, Ill.
Shiffler Bridge Co., Pittsburg, Pa.
Smith, F. H., Baltimore, Md.
Sooysmith & Co., 2 Nassau street, N. Y.
Staats, R. P. & J. H., 29 Broadway, N. Y.
Union Bridge Co., 1 Broadway, N. Y.
Variety Iron Works Co., Cleveland, Ohio.
Waddell, J. A. L., Kansas City, Mo.
Wisconsin Bridge & Iron Co., Milwaukee, Wis.
Wrought Iron Bridge Co., Canton, O.
Youngstown Bridge Co., Youngstown, O.

Bridge Railings.
Albree, Chester B., Allegheny, Pa.

Cables (Electric, Submarine and Wire).
General Electric Co., N. Y. City.

Cableways (Suspension).
Lidgerwood Mfg. Co., 96 Liberty St., N. Y.

Cable Railways (Builders of).
Christie & Lowe, 45 Broadway, New York.
E. Saxton, Washington, D. C.

Cable Railway Driving Plants.
Poole, Robt., & Son Co., Baltimore, Md.

Cameras.
Rochester Optical Co., Rochester, N. Y.

Cars (Dump, Plantation and Flat, Hand Logging, Mining and Freight).
Bloomsburg Car Co., Bloomsburg, Pa.
Carlisle M'f'g Co., Carlisle, Pa.
Carey Car & Mfg. Co., Chicago, Ill.
Evans, Geo. A., 40 Wall St., New York.
Fairbanks, Morse & Co., Chicago.
Jackson & Woodin M'f'g Co., Berwick, Pa.
Males, A. S., & Co., Cincinnati, O.
Ryan-McDonald Mfg. Co., Baltimore, Md.
Sheffield Velocipede Car Co., Three Rivers, Mich.
Stuebner, G. L. & Co., Long Isl'd City, N.Y.

Cars (Railroad, Passenger and Freight).
Bloomsburg Car Co., Bloomsburg, Pa.

Cars (Wrecking and Ditching).
Bucyrus Steam Shovel & Dredge Co
Industrial Works, Bay City, Mich.
Marion Steam Shovel Co., Marion, O.

Car Heating and Lighting.
The Safety Car-Heating and Lighting Co., 160 Broadway, New York.

Car Coupler.
Hinson Car Coupler Co., Chicago, Ill.
Janney Hien Co., Pittsburg, Pa.
McConway & Torley Co., Pittsburg, Pa.

Car Doors and Replacer.
The Q & C Co., Chicago, Ill.

Car Wheels.
Jackson & Woodin Mfg. Co., Berwick, Pa.
Lake Shore Foundry, Cleveland, O.
N. Y. Car Wheel Works Co., Buffalo, N. Y.
Ramapo Iron Works, Hillburn, N. Y.

Cattle Guards (Surface).
National Surface Guard Co., Chicago, Ill.

Cement.
Alsen's Portland Cement Works, N. Y.
Brand, James, 81 Fulton St., N. Y.
Brown's Keystone Cement Co., Philadelphia, Pa.
Buckeye Portland Cement Co., Bellefontaine, O.
Cumberland Hydraulic Cement Mfg Co., New York.
Dickinson Brothers & King, N. Y.
Fleming Cement & Brick Co., 23 Liberty St., N. Y.
Johnson & Wilson, 45 Broadway, N. Y.
Lawrence Cement Co., 67 William St., N.Y.
Leslie & Trinkle, 210 So. Third St., Phila.
Meacham & Wright, 98 Market St., Chicago.
Norton, F. O., 92 Broadway, N. Y.
New York & Rosendale Co., 284 B'way, N.Y.
Sinclair & Babson, 18 Exchange Place, N.Y.
Tomkins, Calvin, 130 Broadway, N. Y.
Thiele, E., 78 William St., N. Y.
Union Akron Cement Co., Buffalo, N. Y.
Western Cement Co., 247 W. Main St., Louisville, Ky.

Coal Handling Machinery.
Brown Hoisting and Conveying Co., Cleveland, O.
G. L. Steubner & Co., Long Island City, N.Y.
Williams, White & Co., Moline, Ill.

Colleges (Engineering).
Rensselaer Polytechnic Institute, Troy, N. Y.
University of Illinois, Champaign, Ill.

Concrete Mixer.
Carlin's Sons, Thos., Allegheny, Pa.
Cockburn Barrow & Machine Co., Jersey City, N. J.

Contractors (General).
Bassett Bros., 200 Main St., Buffalo, N. Y.
Boughen Engineering Co., Cincinnati, O.
Brown, Jas. M., & Co., 115 Broadway, N. Y.
Frescoln, S. W., World Bldg., N. Y. City.
Harlow, J. H., & Co., Pittsburg, Pa.
Mairs & Lewis, 18 Br'adway, N. Y.
McCormick Const. Co., St. Louis, Mo.
Moffett, Hodgkins & Clarke, Syracuse, N.Y.
Remington & Co., Chicago, Ill.
Sparks & Evans, 436 Walnut St., Phila.
Staats, R. P. & J. H., 29 Broadway, N. Y.
Woltmann, Keith & Co., 11 Wall St., City.

Contractors' Machinery.
American Hoist & Derrick Co., St. Paul.
Bucyrus Steam Shovel & Dredge Co., Bucyrus, O.
Carlin's Sons, Thos., Allegheny, Pa.
Clafty, John, 48 Dey St., N. Y.
Contractors' Plant Co., Buffalo, N. Y.
Ingersoll-Sergeant Rock Drill Co., N. Y.
Iredell, F. W., 10 Park Place, N. Y.
Lidgerwood Mfg. Co., 96 Liberty St., N. Y.
Middleton, W. S., 52 John St., N. Y.
Mundy, J. S., Newark, N. J.
Parker, Field & Mitchell, Cambridgeport, Mass.
Ryan-McDonald Mfg. Co., Baltimore, Md.
Souther, John, & Co., Boston, Mass.
Toledo F'dry & Mach. Co., Toledo, O.
M. Beatty & Sons, Welland, Ont.

Corrugated Iron, Creosoting.
Carolina Oil & Creosote Co., Wilmington, N. C.
Eppinger & Russell, 160 Water St., N. Y.
Lehigh Valley Creosoting Works, Washington St., Jersey City, N. J.
Old Dominion Creosoting Works, 57 Main St., Norfolk, Va.
Vanderbilt & Hopkins, 120 Liberty St., N. Y.

Damp Course.
Sicilian Asphalt Paving Co., New York.

Damper Regulators.
Standard Thermometer Co., Peabody, Mass.

Ditching Machines.
Austin, F. C., & Co., Chicago, Ill.
Bucyrus Steam Shovel & Dredge Co., Bucyrus, O.
Marion Steam Shovel Co., Marion, O.
Osgood Dredge Co., Albany, N. Y.
San Francisco Bridge Co., San Francisco, Cal., Seattle, Wash., and 183 World Bldg., N. Y.
Toledo Foundry & Machine Co., Toledo, O.
Atlantic Dredging Co., 39 Pine St., N. Y.
Urie Dredge Mfg. Co., Kansas City, Mo.
Vulcan Iron Works, Chicago, Ill.

Drilling, Tapping, Reaming and Boring Machines (Portable).
Stow Flexible Shaft Co., Philadelphia
Stow Mfg. Co., Binghamton, N. Y.

Duplex Steam Trap.
Curtis Regulator Co., Boston, Mass.

Dynamite and Electric Blasting Apparatus.
Ætna Powder Co., Chicago, Ill.
Arthur Kirk & Son, Pittsburg, Pa.
Rendrock Powder C., 23 Park Pl., N. Y.

Electric Indicating and Recording Instruments.
Standard Thermometer Co., Peabody, Mass.

Engines (Gas).
Otto Gas Engine Works, Philadelphia, Pa.

Engines (Hoisting)
American Hoist & Derrick Co., St. Paul.
Beatty, M., & Sons, Welland, Ont.
Carlin's Sons, Thos., Allegheny, Pa.
Forsaith, S. C., Machine Co., Manchester, N. H
Industrial Works, Bay City, Mich.
Iredell, F. W., 10 Park Pl., N. Y.
Lidgerwood Mfg. Co., 96 Liberty St., N. Y.
Parker, Field & Mitchell, Cambridgeport, Mass.
Ryan-McDonald Mfg. Co., Baltimore, Md.

Engines (Stationary).
Carlin's Sons, Thos., Allegheny, Pa.
Carlisle Mfg. Co., Carlisle, Pa.
Forsaith, S. C., Machine Co., Manchester, N. H.
Iredell, F. W., 10 Park Place, N. Y.
Poole, Robert, & Son Co., Baltimore, Md.
Southwark F'dry & Mach. Co., Phila.

Engines (Traction).
O. S. Kelly Co., Springfield, O.
Poole, Robert, & Son Co., Baltimore, Md.
Porter Mfg. Co., Syracuse, N. Y.
W. C. Oastler, 43 Exchange Place, N. Y.

Expansion Steam Trap.
Curtis Regulator Co., Boston, Mass.

Filters.
Cumberland Mfg. Co., Boston, Mass.
New York Filter Co., 145 B'way, N. Y.

Fire Brick, Clay and Flue Linings
Montague & Co., Chattanooga, Tenn.
Ohio Sewer Pipe Co., Pittsburg, Pa
Park Fire Clay Co., Pittsburg, Pa.
Sharon Clay Mfg. Co., Sharon, Pa.
Staten Isl. Terra Cotta Co., Woodbridge, N. J., and N. Y.
United States Fire Clay Co., Pittsburg, Pa.

Fire Proofing Material.
Ohio Sewer Pipe Co., Pittsburg, Pa.
United States Fire Clay Co., Pittsburg, Pa.

Flush Tanks.
Flush Tank Co., Chicago., Ill.

Flexible Joint (for Water, Gas, St'm).
Holmes, L., Grand Rapids, Mich.

Frogs and Switches.
Carlisle Mfg. Co., Carlisle, Pa.
Males, A. S., & Co. Cincinnati, O.
Pennsylvania Steel Co., Steelton, Pa.
Ramapo Iron Works, Hillburn, N. Y.
Union Switch, & Signal Co., Swissvale, Pa.
Weir Frog Co., Cincinnati, O.

Gages (Steam).
Standard Thermom. Co., Peabody, Mass.

Girders & Turntables. (See Bridges.)

Grading Machines (Road).
Austen Mfg. Co., F. C., Chicago, Ill.

Granite.
Booth Brothers & Hurricane Isle Granite Co., 60 Bank St., N. Y.
Southern Granite Co., Cincinnati and Atlanta.

Graphite.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Grips (Cable Ry.)
Robert Poole & Son Co., Baltimore, Md.

Hexagonal Turnbuckles.
Central Iron & Steel Co., Brasil, Ind.

Hoisting Buckets.
Stuebner, G. L. & Co., 168-170 E. 3d St., Long Island City, N. Y.

Hoisting & Conveying Machines.
Brown Hoisting & Conveying Machine Co., Cleveland, O.
King Bridge Co., Cleveland, O.
Lidgerwood Mfg. Co., New York.
Link Belt Machinery Co., Chicago, Ill.

Hydrant (Fire).
Beaumont, Richard, Kankakee, Ill.
Chapman Valve Mfg. Co., Ind. Orch., Mass
Eddy Valve Co., Waterford, N. Y.
Michigan Brass & Iron Wks., Detroit, Mich.
Holly Mfg. Co., Lockport, N. Y.
Holyoke Hydr. & Ir. Wks., Holyoke, Mass.
Ludlow Valve Mfg. Co., Troy, N. Y.
Mellert F'dry & Machine Co., Reading, Pa.
Pansaat & Rogers, 18 Gold St., New York.
Peet Valve Co., Boston, Mass.
Rensselaer Mfg. Co., Troy, N. Y.
Ross Valve Co., Troy, N. Y.
Wood, R. D., & Co., 400 Chestnut St., Phila.

Hydraulic Jacks.
Dienelt & Eisenhardt, Philadelphia, Pa.

Hydraulic Machinery.
Watson & Stillman N. Y. City.

Inspection of Bridges and Rolling Stock.
Colby, J. A., Gerard Bdg. Philadelphia, Pa.
Estrada, Kenyon & Gray, Pittsburg, Pa.
Ferris & Co., G. W. G., Pittsburg, Pa.
Hildreth & Co., E. W., 2 Wall St., N. Y.
Hunt Clapp, 95 Fifth Ave., Pittsburg, Pa.
Landreth, Olin H., Nashville, Tenn.
Ricketts, Palmer C., 17 First St., Troy, N. Y.
Robert W. Hunt Co., Chicago, Ill.
Stebbings, W. L., 22 Fifth Ave., Chicago, Ill.

Instruments (Engineers and Surveyors)
Altenederr, T., 355 No. 10th St., Phila., Pa.
Beckmann, L., Toledo, O.
Brightly, Chas. H., Philadelphia, Pa.
Buff & Berger, Boston, Mass
Eddy, Geo. M., Brooklyn, N. Y.
Fauth & Co., Washington, D. C.
Frost & Adams, 37 Cornhill, Boston, Mass.
Gurley, W. & L. E., Troy, N. Y.
Heer & Soelig, 194 Madison St., Chicago, Ill.
Keller & Brightly, Philadelphia, Pa.
Keuffel & Esser Co., 127 Fulton St., N. Y.
Mahn & Co., St. Louis, Mo.
Pfister, Herm., 196 W. 5th St., Cincinnati, O.
Queen & Co., Philadelphia, Pa.
Randolph, T. F., 51 W. Fourth St., Cinc., O.
Young & Sons, 43 N. Seventh St., Phila.

Labor (Italian).
Bruno, Jos., East Boston, Mass.
Cuozzo, Donato, 396 Broome St., N. Y. City.

Land Filling Machines.
San Francisco Bridge Co., San Fr'sco, Cal.

Landscape Architect.
Howell, D. J., Nat. Union Bdg., Washingt'n.
Ricker & Wing, 112 White Bdg., Buffalo, N.Y.

Lock Nut.
Young's Pat. Reversible Nut Lock, N. Y.

Locomotives.
Baldwin Locomotive W'ks, Philadelphia.
Carlin's Sons, Thomas, Allegheny, Pa.
Evans, Geo. A., 40 Wall St., New York.
Iredell, F. W., 10 Park Place, N. Y. City.
Males, A. S., & Co., Cincinnati, O.
Pittsburg Loco. & Car W'ks, Pittsb'rg, Pa.
Porter, H. K., & Co., Pittsburg, Pa.
Ryan-McDonald Mfg. Co., Baltimore, Md.

Lubricants.
Jos. Dixon Crucible Co, Jersey City, N. J.

Lumber (Car and Bridge).
Alfred J. Murray, New York.
Lehigh Vy. Creosot. Co., Jersey City, N. J.
Vanderbilt & Hopkins, New York.

Measuring Tapes.
Eddy, Geo. H. & Co., 345-353 Classon Ave., Brooklyn, N. Y.

Meters (Water).
Hersey Mfg. Co., South Boston, Mass.
Thomson Meter Co., Brooklyn, N. Y.
Union Water Meter Co., Worcester, Mass.
Worthington, Henry R., New York.
National Meter Co., 292 B'way, New York.

Mortar Colors.
Tomkins, Calvin, 130 Broadway N. Y.

Motors (Water).
Backus Water Motor Co., Newark, N. J.
Worthington, H'y R., 36-39 Liberty St., N.Y.
Pelton Water Wheel Co., N. Y. City and

Nut Locks.
Metcalf, Paul & Co., Pittsburg, Pa.

Ore Handling Machinery.
Brown Hoisting & Conveying Mach. Co., Cleveland, O.
Lidgerwood Mfg. Co., New York.

Paints.
Fleming Cement & Brick Co., 23 Liberty St., N. Y.
Jos Dixon Crucible Co., Jersey City, N. J.
National Paint Works, Williamsport, Pa.
Warren Chem. & Mfg. Co., 81-83 Fulton St., New York.

Patent Law.
Fitzgerald, W. T., Washington, D. C.
Smith, Jesse M., 36 Moffatt Bl'k, Det., Mich.

Paving (Asphalt).
Barber Asphalt Paving Co., 1 B'way, N. Y.
Hastings Pavement Co., 140 Pearl St., N. Y.
Neuchatel Asphalt Co., 265 B'way, N. Y.
Sicilian Asphalt Pav. Co., Times Bldg., N.Y.

Paving Block (Stone).
Booth Bros. and Hurricane Island Granite Co., 60 Bank St., N. Y.
Carpenter Bros., Port Chester, N. Y.
Southern Granite Co., Cinc., and Atlanta.

Paving Block (Wood).
Lehigh Vy. Creosoting Co., Jersey City.
Ohio Paving Co., Columbus, O.

Paving Brick (Fire Clay).
American Fire Clay Co., Toronto, O.
Ohio Sewer Pipe Co., Pittsburg, Pa.
Ohio Paving Co., Columbus, O.
United States Fire Clay Co., Pittsburg, Pa.
Freeman Fire Clay Co., Freeman, O.
Ohio Valley Fire Clay Co., Toronto, O.
Park Fire Clay Co., Pittsburg, Pa.

Phosphor-Bronze.
Phosphor-Bronze Smelting Co., Phila., Pa.

Pile Driving Machinery.
Beatty & Sons, M., Welland, Ont.
Bucyrus St. shov. & Dredge Co., Bucyrus, O.
Industrial Works, Bay City, Mich.
J. S. Mundy, Newark, N. J.
Lidgerwood Mfg. Co., 96 Liberty St., N. Y.
Males, A. S., & Co., Cincinnati, O.
Ryan-McDonald Mfg. Co., Baltimore, Md.
Toledo Foundry & Machine Co., Toledo, O.
Vulcan Iron Works Chicago, Ill.

Pipe (Cast Iron).
Addyston Pipe and Steel Co., Addyston, O.
Chattanooga Fdy. & Pipe Works, Chatt'ga.
Donaldson Iron Co., Emaus, Pa.
Drummond, M. J., 192 Broadway, N. Y.
Fairbanks, Morse & Co., Chicago.
Glamorgan Company, Lynchburg, Va.
Howard-Harrison Iron Co., St. Louis.
Jackson & Woodin Mfg. Co., Berwick, Pa.
Long & Co., Dennis, Louisville, Ky.
Lake Shore Foundry, Cleveland, O.
McNeal F'dry & Pipe Co., Burlington, N. J.
Mellert F'dry & Machine Co., Reading, Pa.
Millar, Chas. & Son, Utica, N. Y.
National Fdy. & Pipe W'ks, Scottdale, Pa.
Ohio Pipe Co., Columbus, O.
Pancoast & Rogers, 28 Platt St., New York.
Radford Pipe and F'dry Co. Cincinnati, O.
Warren Fdy. & Mach. Co., 160 B'way, N.Y.
Wood, R. D., & Co., 400 Chestnut St., Phila.

Pipe (Culvert).
Blackmer & Post, St. Louis Mo.
Freeman Fire Clay Co., Freeman, O.
Lookout Sewer Pipe Co., Chattan'ga, Tenn.
Ohio Sewer Pipe Co., Pittsburg, Pa.
United States Fire Clay Co., Pittsburg, Pa.

Pipe (Spiral Riveted).
Abendroth & Root Mfg. Co., N. Y.

Pipe (Wrought Iron).
National Tube W'ks Co., McKeesport, Pa.
Sumner & Goodwin, 15 Oliver St., Boston

Pipe (Wyckoff Water).
Michigan Pipe Co., Bay City, Mich.

Pipe Laying (Contractors).
Harlow & Co., J. H., Pittsburg, Pa.

Pneumatic Foundations.
Anderson & Barr, 240 11th St., Jersey City, N. J.
Sooysmith & Co., 2 Nassau St., N. Y.

Portable Drills, Tapping & Boring Tools.
Jas. H. Harlow & Co., Pittsburg, Pa.
Stow Flexible Shaft Co. (Ltd.), Phila., Pa.

Power Hammers.
Forsaith & Co., S. C., Manchester, N. H.
Dienelt & Eisenhardt, Philadelphia, Pa.

Pressed Steel Goods.
Schoen Mfg. Co., Pittsburg, Pa.

Pressure Regulator for Steam.
Curtis Regulator Co., Boston, Mass.

Pressure Regulators (Water).
Ross Valve Co., Troy, N. Y.
Curtis Regulator Co., Boston, Mass.
Standard Thermom. Co., Peabody, Mass.
Union Water Meter Co., Worcester, Mass.

Prospecting Drills, Electric.
Gen'l Elect. Co., New York.

Pumps & Pumping Machinery.
Barr Pump, Engine Co., Philadelphia, Pa.
Geo. F. Blake Mfg. Co., N. Y. and Boston.
Buffalo St'm Pump Co., Tiffany Pump, N. Y.
Cameron, A. S., Steam Pump W'ks, ft. of 23d St., N. Y.
Carlin's Sons, Thomas, Allegheny, Pa.
Cook Well Co., 703-705 Market St., St. Louis, Mo.
Davidson, M. T., Brooklyn, N. Y.
Deane St. Pump Co., The, Holyoke, Mass.
Dean Bros.' St. Pump W'ks, Ind'nap's, Ind.
Fairbanks, Morse & Co., Chicago.
Forsaith, S. C., Manchester, N. H.
Gordon Steam Pump Co., The, Hamilton, Holly Mfg. Co., Lockport, N. Y.
Hughes Steam Pump Co., Cleveland, O.
Knowles St. Pump W'ks, N.Y. and Boston.
Laidlaw & Dunn Co., The, Cincinnati, O.
Maslin, John & Son, Jersey City, N. J.
Norwalk Iron Wks. Co., S. Norwalk, Conn.
Nye Steam Vacuum Pump Co., Chicago.
Oil Well & Sup. Co., Ltd., 82 Fulton St., N.Y.
Pulsometer Steam Pump Co., New York.
Smith and Vaile Co., Dayton, O.
Southwark F'dry & Mach. Co., Phila., Pa.
Worthington, Henry R., New York.
Van Duzen & Tift, Cincinnati O.
Carlin's Sons, Thomas, Allegheny, Pa.
Edwards, Joseph & Co., 412 Water St., N.Y.
Southwark F'dry & Machine Co., Phila., Pa.
Van Wie, Irwin, Syracuse, N. Y.

Pumps (Hand Power).
Boston & Lockport Block Co., Boston, Mass.

Rail Joints.
Males, A. S., & Co., Cincinnati, O.
McConway & Torley Co., Pittsburg, Pa.
Pennsylvania Steel Co., Steelton, Pa.
Price, Jas. M., Philadelphia, Pa.
Q. & C. Co., Chicago.

Rails (Steel).
Evans, Geo. A., 16 Wall St., N. Y.
Iredell, F. W., 10 Park Place, N. Y.
Males, A. S., & Co., Cincinnati, O.
Pennsylvania Steel Co., Steelton, Pa.

Railroad Ballast.
Carpenter Bros., Portchester, N. Y.

Railroad Castings.
Ramapo Iron Works, Hillburn, N. Y.

R. R. Car Unloaders.
Marion Steam Shovel Co., Marion, O.

Railroad Culvert Pipe.
Addyston Pipe & Steel Co., Addyston, O
Ohio Sewer Pipe Co., Pittsburgh, Pa.
Blackmer & Post, St. Louis, Mo.
United States Fire Clay Co., Pittsburg, Pa

Railroad Equipment.
Carlisle Mfg. Co., Carlisle, Pa.
Evans, Geo. A., 40 Wall St., N. Y.
Iredell, F. W., 10 Park Place, N. Y.
Males, A. S., & Co., Cincinnati, O.
Middleton, W. S., 52 John St., N. Y.

Railroad Interlocking, Switching and Signaling Appliances.
Hall Signal Co., 50 Broadway, N. Y.
Johnson Railroad Signal Co., Rahway, N.J.
Pennsylvania Steel Co., Steelton, Pa.
Ramapo Iron Works, Hillburn, Rockland Co., N. Y.
Weir Frog Co., Cincinnati, O.
Union Switch & Signal Co., Swissvale, Pa

Road Rollers.
Carlin's Sons, Thos., Allegheny, Pa.
Enterprise Mfg. Co., Columbiana, O.
Harrisb'g Fdy. Mach. W'rks, Harrisb'g, Pa.
O. S. Kelly Co., Springfield, O.
Pope, R. C., Chicago, Ill.
Vulcan Iron Works, Chicago, Ill.
W. C. Oastler, 43 Exchange Place, N. Y.

Rock Drills.
Arthur Kirk & Son, Pittsburg, Pa.
Clayton Air Compr. W'ks, 42 Dey St., N.Y.
General Electric Co., New York.
Ingersoll-Sergeant Rock Drill Co., N. Y.
Rand Drill Co., N. Y. City.

Rock and Ore Crushers.
Farrell F'dry & Mach. Co., Ansonia, Conn.

Scrapers.
Fairbanks, Morse & Co., Chicago.

Sewer Brace.
Dunn Mfg. Co., Pittsburg, Pa.

Sewer Excavating and Hoisting Apparatus.
Carson Trench Machine Co., Boston, Mass.

Sewer Pipes.
Blackmer & Post, St. Louis, Mo.
Lookout Sewer Pipe Co., Chattan'ga, Tenn.
Montague & Co., Chattanooga, Tenn.
Ohio Sewer Pipe Co., Pittsburg, Pa.
Ohio Vy. Fire Clay Co., Toronto, Jefferson Co., O.
United Stutes Fire Clay Co., Pittsburg, Pa.
Warner, Henry A., New Haven, Conn.

Sewage Pumping Machinery.
Gordon Steam Pump Co., Hamilton, O.
Worthington, Henry R., 86 Lib'ty St., N.Y

Shafts (Flexible).
Stow Flexible Shaft Co. (Ltd.), Phila., Pa.
Stow Mfg. Co., Binghamton, N. Y.

Sheet Iron Works.
Cincinnati Corrugating Co., Piqua, O.

Skylights.
Valle & Young, Baltimore, Md.

Stand-Pipes.
Cunningham Iron Works, Boston, Mass.
Fairbanks, Morse & Co., Chicago.
Hodge, E., & Co., East Boston, Mass.
Porter Mfg. Co., Syracuse, N. Y.
Riter & Conley, Pittsburg, Pa.
Stearns Mfg. Co., Erie, Pa.
Tippett & Wood, Phillipsburg, N. J.
U. S. Wind Eng. & Pump Co., Batavia, Ill.
Wood, R. D., & Co., 400 Chestnut St., Phila.

Steam Damper Regulator.
Curtis Regulator Co., Boston, Mass.

Steel Freight Cars.
Harvey Steel Car Works, Chicago, Ill.

Steel Castings.
Chester Steel Cast. Co., 407 Libr'y St., Phila.
Congdon Brake Shoe Co., Chicago, Ill.
Standard Steel Casting Co., Thurlow, Pa.

Steel Castings (Open Hearth).
Carbon Steel Co., Pittsburg, Pa.

Steel (Pressed).
Schoen Mfg. Co., Pittsburg, Pa.

Steel Plates.
Carbon Steel Co., Pittsburg, Pa.

Street Railway Track.
Duplex Str. Ry. Track Co., 51 Wall St., N.Y.

Tackle Blocks.
Boston & Lockport Bl'ck Co., Boston, Mass.

Tanks (Cedar).
Fairbanks, Morse & Co., Chicago.
U. S. Wind Eng. & Pump Co., Batavia, Ill.

Tapping Machines (for Water and Gas Pipe).
Harlow & Co., J. H., Pittsburg, Pa.
Mueller Mfg. Co., H., Decatur, Ill.

Tar Heating Tanks (Portable).
O. S. Kelly Co., Springfield, O.

Temperature Regulator.
Standard Thermom. Co., Peabody, Mass.

Testing Laboratory.
Hunt & Clapp, 95 5th Ave., Pittsburg, Pa.
Olin H. Landreth, Vanderbilt Univ., Nashville, Tenn.
Riehle Bros., Philadelphia, Pa.
Robert W. Hunt & Co., "The Rookery, Chicago, Ill.

Testing Machines.
Riehle Bros., Philadelphia, Pa.

Terra Cotta Goods.
Montague & Co., Chattanooga, Tenn.
Ohio Valley Fire Clay Co., Toronto, O.
Staten Island Terra Cotta Lumber Co. Woodbridge, N. J., and N. Y. City.

Thermometers.
Standard Thermom. Co., Peabody, Mass.

Tie Plates.
The Q. & C. Co., Chicago, Ill.

Tires (Steel).
Prosser, Thos., & Son, 15 Gold St., N. Y

Track Drill.
Car Truck Suppl Co., Chicago, Ill.

Track Tools.
Fairbanks, Morse & Co., Chicago.
Metcalf, Paul & Co., Pittsburg, Pa.

Transmission Machinery.
General Electric Co., New York.
Link Belt Machinery Co., Chicago, Ill.
Poole, Robt., & Son, Co., Baltimore, Md.

Trench Machines.
Carson Trench Machine Co., Boston, Mass.

Valves (Safety and Water Relief).
Ashton Valve Co., Boston, Mass.

Velocipedes (R. R.
Sheffield Veloc. Car Co., Three Rivers, Mich.

Water and Gas Specialties.
Mueller Mfg. Co., Decatur, Ill.

Water Pressure Regulator.
Curtis Regulator Co., Boston, Mass.

Wheelbarrows.
Stuebner G. L. & Co., L. I. City, N. Y.
Cockburn & Barrow Mach Co., Jersey City

Wind Mills.
Fairbanks, Morse & Co., Chicago.

WANTS. 50 Cts

50 Cts

Cards of not more than one-half inch will be inserted in this column once for 50 cts., or three times for $1.00. Paper sent at request only, 15 cts. additional.

WANTED—All consulting engineers, corporations, contractors, etc., to read Paret's advertisement about surveys. See page III.

WANTED—Continuous girders or drawbridges to calculate—either constant or variable moment of inertia. New graphical method. Address, C. H. LINDENBERGER, Wayne Hotel, Detroit, Mich.

WANTED—Position as inspector of bridges and buildings or superintendent of bridges during erection. Thoroughly acquainted with the business in all its branches. Address 477, Engineering News. 41-13t

WANTED.—Civil engineer, age 34, 18 years' experience on railroads, water-works, sewers, roads, as engineer and superintendent, good draftsman, full set instruments, steady habits. Address GRAHAM, care Engineering News. 43-tf

A RELIABLE AND COMPETENT foreman, who has first class references, and is experienced both North and South in reservoir, sewer, pipeline, concrete work and roadmaking, is a correct timekeeper and has a knowledge of accounts, desires a position of some responsibility with engineer, contractor or mfg. company; has also facilities for and could board from fifty to two hundred men if required. Address SCOTCHMAN, care Engineering News. 44-tf

WANTED—Position as chief engineer by Yale graduate. Mem. Am. Soc. Civil Engrs. Have had 21 years' experience in only five companies in the hardest and heaviest railroad work in this country and in Mexico. Desires correspondence with anyone forming new companies. The very best references can be furnished at the Engineering News office, by addressing CHIEF ENGINEER. 44-tf

WANTED.—Open for a situation, superintendent of construction in earth rock, masonry or track. Experience and references. "ABILITY," care Eng. News. 48-15t

WANTED—Position as engineer for bridge company, or engineer of bridges and buildings for railroad company. Can take charge of any kind of construction. Highest references. Address "170," Engineering News. 40-tf

WANTED.—A young engineer desires employment evenings. Good calculator and draftsman; can plat city and railway map-work, profiles, etc., from notes, and is competent to do general work in engineer's office. Address, "H. S. C.," Engineering News.

MARRIED MAN—With over ten years' experience on the construction and maintenance of railroads, desires a position of some permanence on maintenance of way; is a hustler; fair draftsman, and is familiar with present practice; references furnished; is employed at present. Address correspondence to J. O. C., care Engineering News 51 3t

WANTED—Position as bridge draftsman. Experience as computer. Has also made some important contributions to the theory of strains in bridges. Is an Assoc. Am. Soc. C. E. Northern middle states preferred. Address L., care Engineering News. 51-3t

WANTED.—A graduate civil engineer of nine years' experience on first class railroads desires engagement to make location surveys, estimates and specifications, or to take charge of construction; has complete outfit. Address A. B., Engineering News. 51-3t

WANTED—Two exeprienced mechanical draftsmen. Apply to the SCHUYLER ELECTRIC CO., Middletown, Conn., stating experience, salary expected, and references. 51-3t

WANTED.—An engineer experienced in railway location and construction, both in flat and mountain country, wishes engagement. Best of references. "RAILWAY ENGINEER," care Eng. News. 51-3t

AFTER DEC. 15, 1892.—Engineer experienced in survey and construction of railways and sewers, desires position. References upon application. H. W. NEWBY, Avoca, Pa. 51-tf

WANTED—Position by a young C. E. as rodman or tapeman on railway work of any kind, or as assistant in town site or city engineering. Would accept a position in any surveying or engineering work. Can handle the instruments. Age 23. Address H. I. S., Box 160, Frankfort, Ross Co., Ohio. 51-4t

WANTED.—To Electrical and Civil Engineers! A young man, aged 16, good education, wishes to enter engineer's office with opportunity to learn the business; salary no object; A1 references, and security if required. Address "AMERICAN," care Engineering News. 51-3t

ESTABLISHED 1890.

The Engineering Employment Bureau,

GRANGER BLOCK, SYRACUSE, N. Y.

The first Agency established for furnishing Engineering Help exclusively.

No Charge to Employers.

Prompt. Honest. Experienced.

AMERICAN

Engineering Employment Office,

11 Niagara St., BUFFALO, N. Y.

QUICK. HONEST. TRUSTWORTHY.

Employers furnished with Engineers, Chemists and Draftsmen without charge.

Employees, give your name and address to the office at once.

WANTED.—English mechanical engineer and draftsman, university training, varied experience, wishes position with good opportunities, moderate salary; has held responsible positions; thoroughly reliable and competent. Address "DEVIS," care Engineering News. 51-3t

WANTED—An engineer desires engagement; lately principal assistant on the Chignecto Ship Railway; large experience on railway, harbor, dock work, etc.; railway location and construction specialty; full set instruments. Address, J. S. ARMSTRONG, Room 43, No. 22 William St., New York. 51-3t

WANTED—Position by a first class engineer with experience in iron buildings and bridges. Can take charge of office work. Chicago preferred. Address E. R., Eng. News. 52-3t

WANTED.—A civil engineer, with ten years' experience on R. R. construction and operation, in charge of grading, tracklaying, ballasting, and maintenance of way, is open to engagement Jan. 1. Address D. H., care Engineering News. 52-4t

WANTED—Assistant draftsman on iron bridge and structural iron work. Must be able to compute strains in bridges and roof trusses, and make shop drawings. State salary wanted. References required. THE BUCHANAN BRIDGE CO., Bellefontaine, O. 52-3t

A GRADUATE C. E. and land surveyor, having five years' experience as city engineer and two years on railroad works, wants a position as city engineer, railroad bridge work, etc. P. L. S., care Engineering News. 52-3t

IN A FEW DAYS locating and resident engineer will be open for engagement. Have good instrumental outfit; strictly temperate, age 34, a "hustler." "J. F. H.," care Eng. News. 52-6t

UNIVERSITY GRADUATE in engineering, nine months' experience in office work and surveying, good draftsman, shortly disengaged, desires position on construction of any kind, or on a survey party. Will go any place. GRADUATE, care Eng. News. 52-3t

WANTED—A thoroughly first class shop superintendent, familiar with electrical and mechanical work, to superintend equipment and operation of new shops to be erected near New York City. Applicant must have satisfactorily filled similar position in modern machine shop, must be temperate and free from other business interests so as to be able to give his whole time to shop duties. Address by letter, stating experience, references and salary expected. SPRAGUE ELECTRIC ELEVATOR COMPANY, 15 Wall St., N. Y. City. 3t

For Sale.

Engineering News, Vols. 14 to 28 inclusive, complete, except No. 38 of Vol. 16 and Index to Vol. 17; also duplicates, Nos. 4 to 15, inclusive, 25 and 26 of Vol. 11; Nos. 1, 3 to 9, 13 and 16 of Vol. 12; Index to Vol. 14; No. 4 of Vol. 19; No. 10 of Vol. 21, and No. 19 of Vol. 25. Will exchange any two of above extras for missing No. and Index mentioned. Will accept the best offer made before Feb. 1. Address FLUSH TANK, 114 West Markham St., Little Rock, Ark. 53-4t

FOR SALE—Marion steam shovel No. 129, style A, used only portion of last season, and absolutely as good as new. For particulars address S. CASPARIS, Marble Cliff, Ohio. 52-3t

CONTRACTOR'S PLANT.

FOR SALE—One Souther shovel, one 8-ton Porter locomotive, 37 dump cars, 3-ft. gage. JOHN CLAFFY, 48 Dey St., New York City. 53-tf

FOR SALE OR RENT.

1 Ten-ton Harrisburg steam road roller one year old for sale or rent, with engineer.
2 9×15 Farrel crushers, with engines and boilers.
1 10×20 Farrel crusher, with engine and boiler.
1 H. K. Porter's locomotive, 6 tons.
Address H. S. CASWELL, Wakefield, R. I. 51-tf

FOR SALE—2 Marion steam shovels; 100 dump cars; 3 locomotives; ballast unloader; rails 30 and 60-lb. in order to relay; hoisting engines; road rollers; pumps; crushers; boilers; condensers; compressors, tanks all sizes; drills; scrapers; dredges; pile drivers; 4,000,000-gallon compound duplex pump; contractors' tools, second hand, in good order; ice machinery and water purifier. W. S. MIDDLETON, 52 John St.

FOR SALE—Twelve 42-in. mills manufactured by Munson Bros., Utica, N. Y. For price and terms, etc., address WALBURN'S PORTLAND CEMENT MFG. CO., Warner's, Onondaga Co., N. Y. 42-tf

TO SELL at a sacrifice, one Young plain No. 7 transit; excellent order; positive guarantee. Address M. RIDDLE, JR., Petersburg, Va. 52-3t

Dredging Plant for Sale.

Eleven dredges, 12 tugs, 32 dump scows, 7 scows, all in first class condition and fully equipped; also 1 machine and blacksmith shop, fully equipped, with all necessary tools, including lathes, drills, planer, steam hammer, etc.; all in first class working order; built on a large scow and can be towed anywhere on the lakes.

Nine dredges with scows, 11 tugs and machine and blacksmith shop at Sault Ste. Marie, Mich.; 1 dredge and scows at Ashtabula, Ohio.; 1 dredge and scows and 1 tug at Dickinson's Landing, Ont., where they may be seen; will sell the whole or any part. For prices, terms, etc., address CARKIN, STICKNEY & CRAM, East Saginaw, Mich. 52-3t

FOR SALE—14 Vols. "Engineering News"—1886 to 1892, inclusive—½ Morocco binding; price, $3 per Vol. Address P. O. Box 85, Kansas City, Mo. 52-6t

FOR SALE.—An extra fine level, Young's make, in perfect order and condition; also 17 ft. English rod, $125 for both. Address E. D. WILEMAN, care L. S. & M. S. R. R. Engineer office, Toledo, Ohio. 52-3t

REMOVAL.

FOR SALE. A RARE CHANCE.

The Real Estate and Buildings of the

FORT SCOTT FOUNDRY & MACHINE WORKS CO.,

At Fort Scott, Kansas.

The Most Successful Foundry and Machine Shop Plant and Best Location in the West.

The Company owning and operating this plant continuously and very profitably for the past fifteen years, having brought out some patented specialties, that are sold mostly in the Eastern States, and also for export, were compelled on this account to locate farther East, and now have under construction at Chicago Heights, Cook Co., Illinois, with largely increased capacity, the buildings for their new plant, and will remove all the machinery in their Fort Scott Works to Chicago, about the 1st of December next.

The buildings are practically new, having been erected in 1886, and from the most modern and approved plans of Foundry and Machine Buildings; are of ample dimensions for large capacity, well lighted, arranged for traveling cranes throughout, location the best in the city, on about thirteen acres of high ground immediately within the Junction, and connected by switches of all the systems of Railways entering Fort Scott.

Fort Scott has been celebrated for cheap fuel, cheap living, and a cheap and very desirable class of both skilled and common labor.

The business was established here twenty-three years ago, and the Works have never been closed. A large general Foundry and Machine Shop trade comes to the city almost daily from half a dozen States and Territories, in close proximity to the great coal, zinc and lead regions of Missouri, Kansas City and Indian Territory.

A rare opportunity for a few practical men to make a fortune. The property will sold at a

Great Bargain and upon Easy Terms.

Photos of the works, together with plans and plans of buildings, and full particulars will be forwarded on application. Address

THE WALBURN-SWENSON MFG. CO.,

1520 Monadnock Block, Chicago.

"THE STEAM ENGINE."

By Daniel Kinnear Clark, C. E., M. I., M. E. Hon. Member A. S. M. E.

A practical and exhaustive work, descriptive of the most modern types of Locomotive, Marine, Stationary and portable Engines, Boilers, Valve Gear, Link Motions, Triple and Quadruple Expansion, Fuel, Forced Draft. 1500 pages; 1,300 diagrams and plates drawn to scale. 4 vols., cloth, $16.00, carriage prepaid. Send for descriptive circulars and our catalogue of new books.

BLACKIE & SON, Ltd.,

73 Bible House, NEW YORK.

SPECIAL.

Please to note that Berg's new book on the "Buildings and Structures of American Railroads" is READY for DELIVERY, and orders will be filled with as little delay as possible. The price is now $7.50, as per advertisement of past months. For sale by ENGINEERING NEWS PUBLISHING CO.

THE VAN VRANKEN

Automatic Flush Tank

FOR FLUSHING SEWERS, DRAINS, ETC.

Tanks Sent on Trial if Desired.

Send for New Illustrated Catalogue.

H. H MITCHELL, Gen'l Agent for U. S., NEWARK, N. J.

HOME STUDY OF

MECHANICS

To commence, students only need to know how to read and write.

Send for FREE Circular to The Correspondence School of Mechanics Scranton Pa.

RAILS AT A BARGAIN.

We own and offer for sale, cheap, 450 tons of selected second-hand 30-lb. IRON RAILS in Chester County, Pa., all in good condition; also 475 tons of second-hand 52-lb. STEEL RAILS at Pittsburgh, Pa. Write or wire us.

ROBINSON & ORR,

No. 419 Wood St., PITTSBURGH, PA.

MACHINERY FOR SALE.

Crushers and Road Rollers.
Hoisting Engines and Machinery.
Contractors' Tools and Machinery of every description in stock.
Brick Plant Machinery.

THOMAS CARLIN'S SONS,

Cor. Federal and Laycock Sts.,

ALLEGHENY, PA.

The Sanitary District of Chicago.

NOTICE TO BIDDERS.

The undersigned begs to inform those having contracts that the same can be furnished with Italian laborers upon special agreement, on favorable conditions; strict and reliable dealings. Address, DONATO CUOZZO, Italian Labor Employment & Supply Agency, 336 Broome St., New York City, N. Y.

N. B.—No orders entertained that require less than 100 men.

DONATO CUOZZO, See Adv., p. iv. *Contractor Italian Labor.*

JOSEPH BRUNO, *Contractor.*

Italian laborers supplied and work superintended. Address 15 London St., East Boston, Mass.

CHARLES P. MARTINO.

Italian laborers supplied for any kind of work; for railroad, water work, stone mason stone cutter, etc. 242 North 5th St., Brooklyn N. Y.

CARPENTER'S CROSS-SECTION PAPER, designed for graphical representation of equations or reports of laboratory experiments, also adapted for use in the drawing-room. Sizes of plates 5x7½ in. and 7½x10 in. Send stamp for samples to ANDRUS & CHURCH, Ithaca, N. Y. 45-13t

HOISTING ENGINES.—Steam pump engines, boilers, machine tools and general mill machinery, both new and second-hand, a specialty. Write us fully, stating just what you want. Over 7,400 machines, new and second-hand, fully described, and prices in our new list just issued. S. C. FORSAITH & CO., Machinists and Machinery Dealers, Manchester, N. H.

Ingersoll Sergeant Air Compressors.

1—14" × 18" Latest Improved Piston Inlet; used 10 weeks.
1—14" × 18" with poppet air valves. Pattern 1889. Good.
These compressors with or without drills, receivers, etc.
1—CLAYTON AIR COMPRESSOR; steam cylinder, 10" × 10"; air cylinder, 12" × 14". Used six months.
2—"BELT COMPRESSORS 14" diam., 12" stroke.
1—9" × 14" LOCOMOTIVE, 36" gauge, Forney type.

Also a full line of NEW BOILERS

READY TO SHIP.

F. W. IREDELL

10 PARK PLACE, NEW YORK.

HOW TO USE PORTLAND CEMENT.—This exceedingly neat and valuable little handbook can be had at the cost of a one cent postal card, by addressing THE BUCKEYE PORTLAND CEMENT CO., Bellefontaine, Ohio.

For other wants see page XII.

NATIONAL PAINT WORKS,

WILLIAMSPORT, PA.,

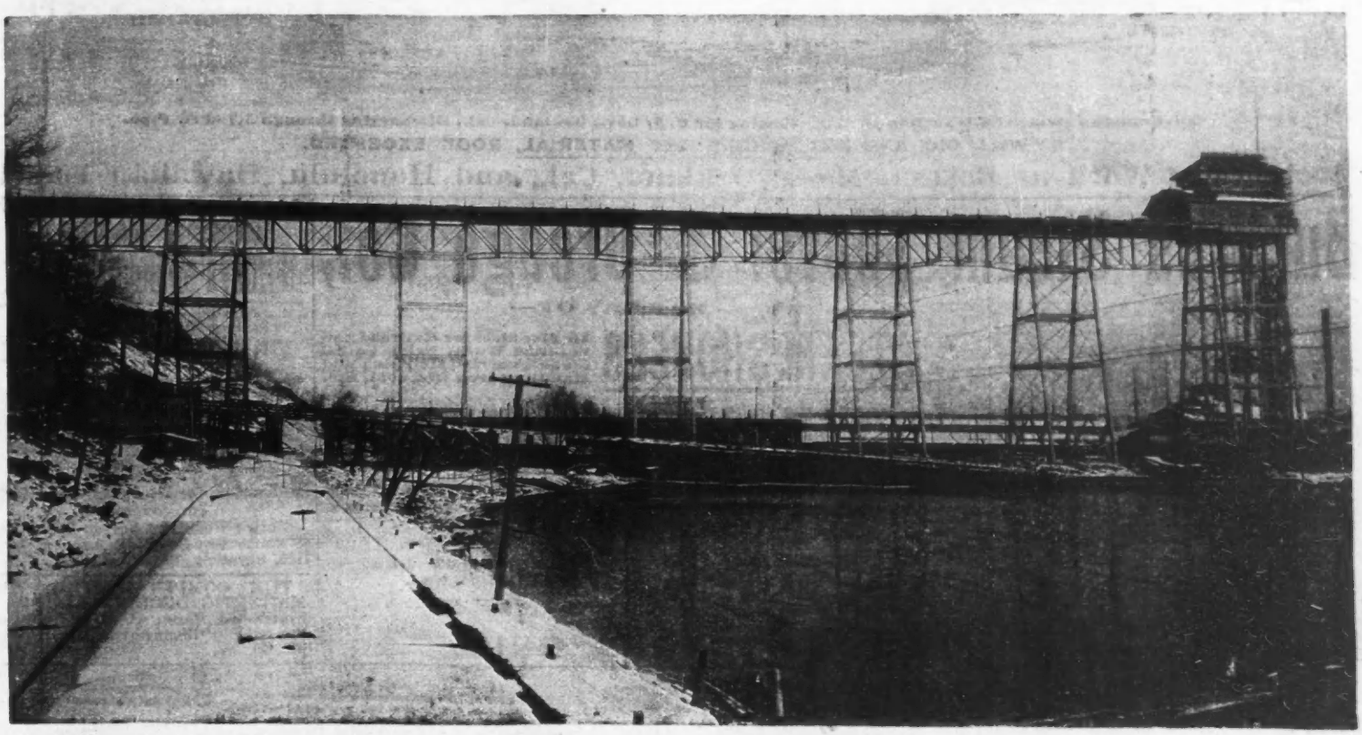
—THE ONLY MANUFACTURERS OF

ELLIOTT'S ASPHALTUM PAINTS,

IN ALL COLORS. MIXED READY FOR USE.

THE RECOGNIZED STANDARD FOR QUALITY.

SALES IN 1879, 1,000 BARRELS. SALES IN 1889, OVER 10,000 BARRELS.



Weehawken Viaduct and Elevators, Passaic Rolling Mill Co., Builders, Painted with Elliott's Asphaltum Nos. 15 and 58.

In the preparation of our paints we use only the very best Lead, Zinc, Minerals, Coloring Materials and Crude Asphaltum, ground in and thinned with PURE LINSEED OIL.

ARE NOT AFFECTED BY THE GASES AND ACIDS RESULTING FROM COMBUSTION OF COAL.
WORK FREELY AND EVENLY WITH A FINISH EQUAL TO THAT OF VARNISHED WORK.
ARE CHEAPER AND AS DURABLE AS ANY FIRST CLASS PAINT IN THE MARKET.
A NON-CONDUCTOR OF HEAT AND WILL STAND 300 DEGREES.

Ten Years' practical experience with our Paints has resulted in their use and adoption as the standard for quality by nearly all of the leading railroads of the country, Bridge Builders, Iron Works, Car Works, and corporation trade generally.

Are Unsurpassed for Depots, Freight Cars, Bridges (wood or iron), Tin or Iron Roofs, Water Tanks, Houses, Barns, Vessels, etc., etc.

To show the popularity of our goods, we mention a few of our customers and a few large structures painted with our Paint:

Central Viaduct, Cleveland, O.
N. Y. C. & St. L. R. R. Viaduct, Cleve., O.
New C. O. R. R. Bridge, Cincinnati, O.
Poughkeepsie Bridge.
New London Draw Bridge.
Denver Cable Road.
Cantilever Bridge, Niagara Falls.
Harvard Bridge, Boston, Mass.
U. S. Gov. Heavy Ordnance Works.
Union Bridge Co.
Phœnix Bridge Co.
Keystone Bridge Co.
Edge Moor Bridge Works.
Pencoyd Iron Works.
Passaic Rolling Mill Co.
Standard Oil Co.
New York Central & H. R. R. Co.
Boston & Albany R. R.
Boston & Maine R. R.
N. Y., N. H. & Hartford R. R.
Pennsylvania R. R.
Richmond & Danville R. R.
Atlantic Coast Line.
East Tenn., Va. & Georgia R. R.
Texas Pacific R. R.
Illinois Central R. R.
Chi. & Northwestern R. R.
Chi., Bur. & Quincy R. R.
Louisville & Nashville R. R.
Ohio & Miss. R. R.
Col., H. V. & Tol. R. R
Lake Shore & M. S. R. R
Western N. Y. & Pa. R.
Southern Pacific R
A., T. & S. Fé R. R.
Missouri Pacific R. R.

Samples, Price-Lists and References from those who have used and are now using these paints in your vicinity furnished on application.

LIDGERWOOD SUSPENSION CABLEWAYS.

LOCKE-MILLER PATENTS.

COPYRIGHT 1891, BY L. M'F'G CO., N. Y.

ALSO MANUFACTURERS —OF— HOISTING ENGINES.

EDISON'S OGDEN MINE CABLEWAY, 1,200 FEET SPAN—DESIGNED AND FURNISHED BY US.

LIDGERWOOD MFG. CO., - - - - 96 Liberty Street, New York.

ESTABLISHED 1877. INCORPORATED 1883. CAPITAL (PAID UP) $250,000.

San Francisco Bridge Company.

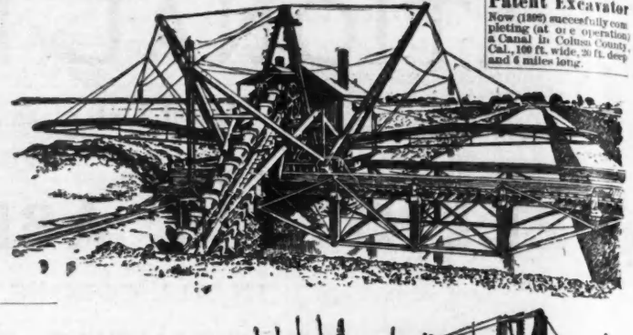
J. McMULLEN, Pres.
J. M. TAYLOR, Sec. and Treas.
GEO. W. CATT, M. Am. Soc. C. E., Vice-Pres.
H. KRUSI, Chief Engineer.
H. S. WOOD,
J. B. C. LOCKWOOD } Engrs.
H. L. COOPER,

OFFICES: { WORLD BUILDING, NEW YORK, N. Y.
SAN FRANCISCO, CAL.; SEATTLE, WASH.

Civil Engineers and Contractors.

SPECIALITIES: Machinery for Economical Excavation of Canals; for Suction Dredging; for Filling and Reclamation of Low Lands.

CORRESPONDENCE SOLICITED.



Patent Excavator
Now (1899) successfully completing (at one operation) a Canal in Colusa County, Cal., 100 ft. wide, 30 ft. deep and 6 miles long.

San Francisco Bridge Co.'s Suction Dredge Working for U. S. Gov., Oakland, Cal., Discharging through 5,700 ft. Pipe.

WILL DIG AND PUT ASHORE ANY MATERIAL, ROCK EXCEPTED.

Machines at Work at Boston, Mass., Oakland, Cal., and Honolulu, Hawaiian Islands.

Bucyrus Steam Shovel & Dredge Co.,

—MAKERS OF—

STEAM SHOVELS In Five Sizes for Railroad and Contract Work, Brick Yards, Stone Quarries, Stripping and Handling Iron Ore, Coal, Etc.

STEAM DREDGES Of All Types and Sizes; for All Purposes; Elevator, Dipper, Clam Shell, Suction. Special Machines for Special Work.

WRECKING CARS BOTH HAND AND STEAM CAPACITIES. 10 to 35 TONS.

PILE DRIVERS WITH EITHER DROP or STEAM HAMMERS.

BUCYRUS, OHIO.

SANFORD ROSS JOS. B. SANFORD

ROSS & SANFORD, Builders of Docks & Bridges

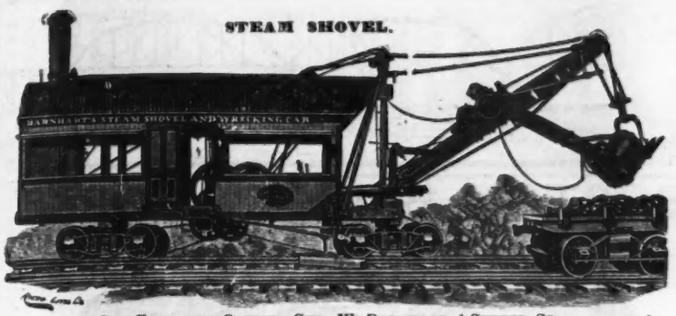
Contractors for Dredging and Harbor Improvements.
Fuller Building, Jersey City, N. J.
21 South Gay St., Baltimore, Md.
116½ Bryan St., Savannah, Ga.

THE COMPUTATION OF THE MAGNETIC DECLINATION. By J. Francis Le Baron, C. E. Price 10 cts. For sale by Engineering News Publishing Co.

Alphabetical List of Advertisers.

	PAGE
Abendroth & Root M. Co.	34
Addyston Pipe & Steel Co.	35
Ætna Powder Co.	5
Alpree, Chester B.	26
Alexander, Hill & Dunlap	2
Alsen's Portland Cement Wks.	36
Altenober, Theo.	16
American Bridge & Iron Co.	27
Am. Eng. Employment Office.	22
American Fire Clay Co.	17
American Hoist & Derrick Co.	29
American Well Works.	14
Anderson & Barr	28
Andrus & Church.	22
Artingstall, asm'l A.	2
Ashton Valve Co.	1
Atlantic Dredging Co.	29
Austin Mfg. Co., F. C.	4
Ayering, Wm. A.	2
Babcock & Wilcox Co.	4
Babcock, John.	9
Babcock, Stephen E	2
Backus Water Motor Co.	12
Bacot, Wm S.	2
Baldwin, stephen W.	36
Baldwin Locomotive Works.	6
Barber Asphalt Paving Co.	36
Bail-Bail Co.	16
Barr Pumping Engine Co	33
Barrath & Co., Edward	2
Bartlett, Gay & Young	4
Bassett Bros.	2
Beatty, M. & Sons.	25
Beaumont, Richard	13
Beckman, L.	16
Berthoud & Musser	2
Binder & Seifert	2
Blackmer & Post Pipe Co.	1
Blake, Geo. F., Mfg. Co.	33
Bloomsburg Car Co.	9
Boggs, Edw. M.	2
Booth Bros. and Hurricane Is. Granite Co.	17
Boston Bridge Works.	26
Boston & Lockport Block Co.	34
Boughen Engineering Co.	32
Bourbon Copper & Brass Works	12
Bouscaren, G.	2
Brand, James.	17
Brightly, Chas. H.	16
Brown Hoisting & Conveying Machine Co.	6
Brown & Co., Jas. M.	2
Brown's Keystoae Cement.	30
Bruno, Jos.	2
Buckeye Portland Cement Co.	17
Bucyrus Steam Shovel & Dredge Co.	24
Buffalo Steam Pump Co.	32
Builder's Iron Foundry	18
Buff & Berger	16
Canton Steel Roofing Co.	2
Cameron, A. S. St'm Pump Wks.	18
Carlin's Sons, Thos.	22
Carlisle Mfg. Co.	8
Carolina Oil & Creosoting Co.	29
Carbon Steel Co.	8
Carpenter Bros.	9
Carson Trench Machine Co.	36
Car Truck Supply Co.	11
Central Iron & Steel Co.	29
Chapman Valve Mfg. Co.	13
Champion Bridge Co.	26
Chattanooga Pipe & Pipe Wks.	28
Chicago Bridge & Iron Co.	27
Christie & Lowe	2
Cincinnati Corrugating Co.	19
Cin., Hamilton & Dayton R. R.	
Clafy, Jones.	9
Clarke, Thomas C.	2
Clayton Air Compressor Works	1
Cockburn Barrow & Mach. Co.	9
Cofrode & Saylor	29
Cofrode & Evans.	28
Colby, J. A.	2
Cole, Jno. A.	2
Congdon Brake Shoe Co.	5
Contractors' Plant Mfg. Co.	4
Corey Car & Mfg. Co.	4
Cooke & Read	2
Cook Well Co., The	14
Cooper, Theodore	28
Correspondence School of Mechanics	17
Crebore, Wm. W	2
Croes, J. James R.	2
Cumberland Mfg. Co.	19
Cunningham Iron Works.	30
Cuozzo, D.	4, 22
Curtis Regulator Co.	26
Dagron, Leo L.	2
Davidson, M. T.	32
Davis, Chester B.	2
Dean Bros. Steam Pump Wks.	31
Deane Steam Pump Co.	34
Deimel & Eisenhart	9
Deniger, T.	2
Dickinson Bros. & King.	17
Dickinson, F. P.	2
Donaldson Iron Co.	35
Drown, Thos. M.	2
Drummond, M. J	2
Dunham & Paine	2
Dunn Mfg Co.	9
Dunham, F. A.	2
Duplex Street Ry. Track Co.	1
Eddy & Co., George M.	6
Eddy Valve Co	13
Edge Moor Bridge Works.	26
Edwards & Co., Joseph	33
Eggleston & Dennis	2
Elmira Bridge Co.	27
Eng. Employment Bureau	20
Engineering Magazine	1, 12
Enterprise Mfg. Co.	4
Eppinger & Russell	29
Estrada, Kenyon & Gray	2
Evans Geo. A	1
Evans, Geo. E.	3
Fairbanks, Morse & Co.	
Fanning, J. T.	30
Farrel Foundry & Machine Co.	32
Fauth & Co.	16
Feind, Bernard	2
Ferris, G. W. G., & Co.	2
Field, Wm. P	2
Flad, Edward	2
Fleming Cement & Brick Co.	17
Flush Tank Co.	1
Forsaith & Co., S. C.	20
For Sale	22
Foster, W.C.	2
Freeman Fire Clay Co.	31
Frescolt, S. W.	2, 26
Frigell, Jos. P.	2
Frost & Adams.	16
Fuller, Frank L.	2
Gordon Steam Pump Co.	32
Gould, W. Reid	17
Gould & White	2
Gould's Mfg. Co., Seneca Falls,	32
Gray, Samuel M.	2
Griffith, Wm.	2
Groton Bridge & Mfg. Co.	27
Guillaume, Alfred	1
Gurley, W. & L. E.	16
Hall Signal Co	1
Harlow & Co., Jas. H.	30
Harris, Robert L.	3
Harrisburg Fdry. Machine Wks.	
Harvey Steel Car Wks	11
Hastings Pavement Co.	17
Hazen, Allen.	2
Heer & Selig	4
Heller & Brightly	16
Hersey Mfg. Co.	14
Hering, Rudolph	2
Hildreth, R. W., & Co.	2
Hill, John W.	3
Hunson Car Coupler Co.	7
Hodge & Co.	30
Holmes, A. L.	12
Holly Manufacturing Co.	33
Holyoke Hydrant & Iron Wks.	13
Howard Harrison Iron Co.	19
Howe, W. B. W.	2
Howell, D. J.	2
Hughes Steam Pump Co	34
Hunt Co., Robt. W	2
Hunt & Clapp	2
Hutton Wm. R.	2
Industrial Works.	25
Ingersoll-Sergeant Drill Co.	5
Iredell, F. W	20
Jackson & Woodin Mfg. Co.	34
Jackson, D. C.	7
Janney-Hein Company.	2
Johnson Railroad Signal Co.	1
Johnson & Wilson.	36
Joseph Dixon Crucible Co.	14
Kandeler, Theo.	28
Kenwood Bridge Co.	28
Kelly, O. S., Co	6
Kennedy, Julian	2
Ketcham & Co. Chas. F.	12
Keuffel & Esser Co	16
King Bridge Co.	27
Kirk & Son, Arthur	19
Knowles Steam Pump Works.	33
Laddiaw & Dunn Co.	34
Lake Shore Foundry.	35
Lancaster & Lancaster.	4
Landreth, Olin H.	2
Lawrence Cement Co.	36
Lawson, W. B.	2
Lehigh Valley Creosoting Wks	29
Lehmann, Karl L	2
Leofred, A	3
Leslie & Trinkle.	11, 36
Lewis, Harry J.	2
Lidgerwood Mfg. Co.	28, 25
Linton, Harvey	4
Livengood, W. C.	26
Locke, A. W. & F. B.	2
Long & Co., Dennis	18
Lookout Sewer Pipe Co	31
Loss & Co., C. E.	3
Lowell, Chas. F.	2
Ludlow Valve Mfg. Co.	13
Lucius, Albert	2
Mahn & Co	16
Mairs & Lewis.	9
Maslin & Son	32
Mason, W. P.	2
McCain, F. J. & Bro.	29
McConway & Torley Co.	7
McCormick Construction Co	
McLeod, John	
McNeal Pipe & Fdry. Co.	35
Massillon Bridge Co.	28
Meacham & Wright	17
Mellert Fdy & Machine Co.	33
Metcalf, Paul & Co.	6
Michigan Brass & Iron Works.	13
Michigan Pipe Co.	34
Middleton, W. S.	22
Mo. Valley Bridge & Iron Wks.	26
Mitchell, H. H	20
Modjeski, Ralph	3
Moffet, Hodgkins & Clarke.	9
Montague & Co.	19
Morse & Son, A. J.	32
Mt. Vernon Bridge Co.	29
Mueller, H., Mfg. Co	14
Mundy, J. S.	29
Municipal Public Works	19, 21
Murray, Alfred J.	28
Nat'l Fdry & Pipe Wks.	35
National Meter Co.	15
National Paint Works.	23
National Surface Guard Co.	11
National Tube Works.	36
New York Filter Co.	28
Neuchatel Asphalt Co., Ltd.	17
N. Y. & Bermudez Co.	17
N. Y. & Rosendale Cement Co.	36
N. Y. Car Wheel Works Co.	36
N. Y. Mastic Works	17
Norton, F. O.	14
Norwalk Iron Works Co.	5
Oastler, W. C.	6
Ohio Pipe Co	35
Ohio Paving Co.	32
Ohio Valley Fire Clay Co.	31
Oil Well Supply Co.	14
Old Dominion Creosoting Wks.	29
Osborne & Son, R. B.	30
Osborn & Co., G. Edw.	20
Osgood, Jos. O	2
Osgood Dredge Co.	25
Ottewell, A. D.	3
Otto Gas Engine Works	5
Paine & Ladd	1
Pancoast & Rogers.	35
Paret, M. P.	3
Park Fire Clay Co.	1
Parker, M. S.	3
Parker, Field & Mitchell	29
Parker, C. O.	3
Parsons, Wm. Barclay	3
Passaic Rolling Mill Co.	28
Pelton Water Wheel Co.	25
Pencoyd Bridge & Const'n Co.	27
Pencoyd Iron Works	27
Penna. Military Academy	3
Pennsylvania Steel Co.	26
Peet Valve Co.	13
Pfister, Herm.	2
Phillips, Hiram	3
Phoenix Bridge Co	26
Phosphor-Bronze Smelting Co.	4
Pittsburg Bridge Co.	28
Pittsburg Locomotive & Car Works.	6
Pittsburg Reduction Co.	18
Platt, Jos. C	2
Poole, Robt. & Son Co.	4
Potter, Alexander	8
Pottsville Iron & Steel Co.	28
Price Railway Appliance Co.	4
Prince, L. M.	16
Prosser & Son, Thomas.	6
Pulsometer Steam Pump Co.	1, 33
Q and C Company	18
Queen & Co	16
Radford Pipe & Foundry Co.	34
Ramapo Iron Works	8
Rand Drill Co.	5
Randolph, T. F.	14
Raymond W. G.	3
Remington & Co.	9
Rendrock Powder Co.	5
Rensselaer Mfg. Co.	12
Rensselaer Polytechnic Institute.	3
Rice, Geo. S	3
Rice, Walter P.	3
Rieker & Wing.	3
Ricketts, Palmer C.	3
Riehle Bros.' Testing Machine Co.	7
Ripley, H. C	3
Riter & Conley	35
Robbins, S. B.	3
Robinson & Orr	22
Rochester Bridge & Iron Wks.	29
Rochester Optical Co.	16
Roebling, John A	3
Rondinella, L. F.	3
Rosenberg, Fred	3
Rosewater, Andrew	3
Ross & Sanford	24
Ross Valve Co	13
Rowe & Rowe.	3
Ryan-McDonald Mfg. Co.	9
Safety Car Heating & Lighting Co.	7
Sanne, Oscar.	3
San Francisco Bridge Co.	24
Saxton, E.	18
Schrader & Son.	12
Schoen Mfg. Co.	8
Schultz Bridge & Iron Co.	27
Schwenke, Kirk & Co	17
Snaiier & Schniglau.	28
Sharon Boiler Works.	3
Sharon Clay Mfg. Co.	34
Shaw, Edw. S.	3
Sheffield Velocipede Car Co.	1
Shiffler Bridge Co.	27
Shipman Steam Engine Co.	4
Sibley College.	1
Sicilian Asphalt Paving Co.	17
Sikes, F. G. & G. R.	3
Slocum, J. C	1
Smith, Frederick H.	3
Smith, Isaac A.	3
Smith, Jesse M.	3
Smith & Valle Co.	33
Snyder, Frank.	3
Sooysmith & Co.	26
Souther, Jno. & Co.	24
Southern Granite Co.	13
Southwark Fdy & Machine Co.	32
Sparks & Evans.	9
Staats, R. P. & J. H.	28
Standard Steel Casting Co.	4
Standard Thermometer Co.	16
Stanwix Engineering Co.	2
Staten Island Terra Cotta Lumber Co., Woodbridge, N. J.	4
Stearns Mfg Co	21
Stebbings, W. L.	1
Stow Mfg. Co.	17
Sumner & Goodwin.	13
Taylor, Jas. T.	3
Temple, J. C.	3
Thacher & Breymann.	
Thiele E.	17
Thomson Meter Co.	11
Tippett & Wood.	30
Toledo Bridge Co	28
Toledo Fdry & Machine Co.	25
Tomkins Co., Calvin.	14
Trautwine's Pocket Book	18
Trinidad Asphalt Refining Co.	36
Tschirgi, Jr., M.	3
Union Akron Cement Co.	17
Union Bridge Co.	27
Union Switch & Signal Co.	1
Union Water Meter Co.	14
United States Fire Clay Co.	31
U. S. Government.	19, 20
University of Illinois.	3
U. S. Wind Engine & Pump Co.	30
Urie Dredge Mfg. Co.	25
Utica Pipe Foundry Co.	10
Valle & Young.	26
Vance & Meddis.	4
Vanderbilt & Hopkins.	29
Van Duzen & Tift.	3
Van Wie, Irwin.	32
Variety Iron Wks. Co.	26
Vermeule, C. C.	4
Von Schon & Garner.	3
Vulcan Iron Works.	26
Waddell, J. A. L.	4
Wakefield Sheet Piling Co.	18
Walburn-Swenson Mfg. Co.	22
Wants.	22
Waring, Jr., Geo. E.	4
Waring, Chapman & Farquhar	4
Warner, Henry A.	12
Warren Chem. & Mfg. Co.	18
Warren Fdy & Machine Co.	35
Warren Scharf Asphalt Paving Co	36
Watson & Stillman.	34
Weir Frog Co.	8
Western Cement Co.	17
Western University of Penna.	3
Westinghouse Air Brake Co.	10
Westinghouse, Church, Kerr & Co.	20, 23
White, Wm. Henry.	4
Wiley & Sons, John.	3
Wilgus, Wm. J	4
Wilkins & Davidson.	
Williams, White & Co.	4
Wilson Brothers & Co.	26
Wisconsin Bridge & Iron Co.	28
Wise & Watson.	4
Woltmann, Keith & Co.	9
Wonders, J. C.	4
Woolman, G. S.	16
Wood & Co., R. D.	18
Worthington, Henry R.	33
Wrought Iron Bridge Co.	27
Yeats & Gibson	4
Young & Sons.	15

STEAM SHOVEL.



SAN FRANCISCO OFFICE : GEO. W. BARNHART, 4 SUTTER ST.

THE MARION STEAM SHOVEL CO.

MANUFACTURERS OF

BARNHART'S STEAM SHOVELS,

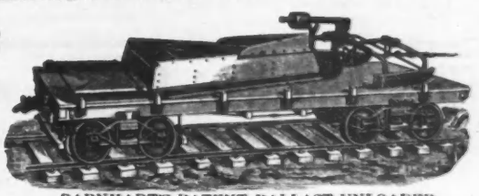
Wrecking Cars, Dredges, Railroad Ditchers, and Ballast Unloader.

All of our Machines guaranteed to give entire satisfaction, otherwise may be returned our expense.

For other information, Photographs, Catalogues and Discounts, address

THE MARION Steam Shovel Co.,

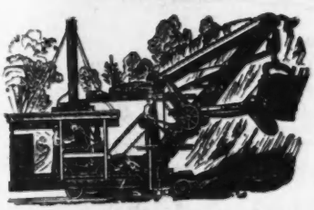
599 West Center St., MARION, O.



BARNHART'S PATENT BALLAST UNLOADER

OTIS & CHAPMAN,

STANDARD GRAVEL AND HARD PAN EXCAVATOR,



MANUFACTURED EXCLUSIVELY BY

John Souther & Co.,

BOSTON.

Earth displaced at ONE-QUARTER LESS EXPENSE than by any other machine.

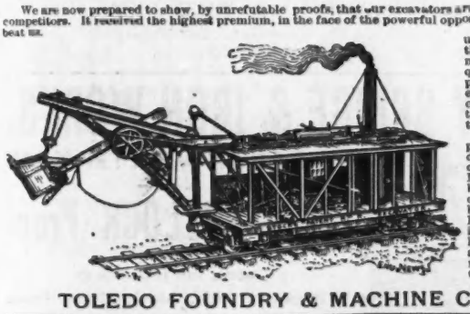
To Whom it May Concern:

I hereby certify that I have used the Otis patent improved Steam Excavators the past twenty years, in all kinds of earth excavation, and believe it to be the best dry land excavator in use, and the only one that will work successfuly in hard pan material. I have excavated and put into cars five million yards under one contract for making land in Boston; with two of these machines I loaded from seventy to eighty thousand yards per month.

N. C. MUNSON.

The Victor Excavator.

We are now prepared to show, by unrefutable proofs, that our excavators are way (a long ways) ahead of all our competitors. It received the highest premium, in the face of the powerful opposition of two rings who conspired to beat us.



It is now admitted by all who have used the different kinds of Excavators that the Victor is the best one on the market. It is the most powerful, quickest working, most durable, best proportioned, easiest handled, fewest parts, least likely to get out of order, and therefore the least expense to keep up, and the cheapest, every thing considered.

Its construction is simplified by patented devices which avoid all complications. It has the best record of any excavator in the country. Its high crane allows it to dig 7 ft. below grade, and can be lowered down in 30 minutes to pass low bridges when running over the road. It has loaded on to flat cars 3,120 yds. in 10 hours, and can excavate any kind of material that can be dug by any other Excavator ever built, and more of it. Send for Illustrated Catalogue.

TOLEDO FOUNDRY & MACHINE CO., Toledo, O.

PEET VALVE CO.

MANUFACTURERS OF PATENT

DOUBLE GATE VALVES

FOR

STEAM, WATER, GAS,

ETC., ETC., ETC.

¼ to 36 inches,

163 ALBANY STREET,

BOSTON, MASS.

ESTABLISHED 1864.

CHARLES F. KETCHAM & CO.

27 & 29 NASSAU ST., NEW YORK,

RAILROAD PRINTERS & STATIONERS

KEEP IN STOCK OF MOST APPROVED FORMS

BOOKS FOR STATION AND TRAIN USE.

BAGGAGE RECORD, CASH, FRT. CONDUCTORS CAR LIST FRT. FORWARDED, FRT. RECEIVED, MANIFEST SHIPPING TEL. TRAIN ORDER, &C., &C.

PAPER AND BOOKS FOR ENGINEERS AND CONTRACTORS USE

BLUE PROCESS, FIELD, QUANTITY, TRACING CROSS SECTION, LEVEL, PROFILE, TRANSIT, DETAILED EST., TIME, PAY ROLL, TOPOG., SO. RETURN, DRAWING, WAGES TABLE, &C., &C.

PRINT, RULE AND BIND IN ANY QUANTITY BLANKS AND BOOKS FOR RAILROADS, AND KEEP STATIONERY FOR ALL.

YOUR ORDERS OR CORRESPONDENCE SOLICITED.

IRRIGATION IN INDIA: ITS VALUE AND Necessity.—By H. M. Wilson, M. Am. Soc. C. E. An extremely interesting and valuable paper showing benefits financial and otherwise which have been derived from Indian irrigation works in the past half century and what Indian and English statesmen and engineers have to say on the subject of the extension of irrigation in that country. Published in ENGINEERING NEWS, Nov. 30, 1901. Price, 15 cents.

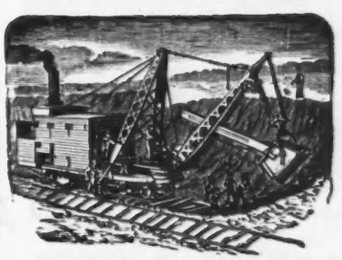
Our Creed.

There is no forcing process for building up a circulation that can be permanently depended on. All temporary expedients based on this principle are, sooner or later, apt to react at a loss. The first and paramount thing is to print a steadily progressive and reliable journal of such merit that, being once seen and read, it will create a demand for the next number.—*Art in Advertising.*

JAMES CLARK, President. ALLEN B. HOWE, Vice-Pres. JOHN K. HOWE, Sec. & Treas

Osgood Dredge Company,

37 State St, ALBANY, N. Y.



Dredges,

Ditching Machines,

Derrick Cars,

Excavators.

INDUSTRIAL WORKS,

BAY CITY, MICH.

CRANES,
WRECKING CARS,
STEAM SHOVELS,
PILE DRIVERS,

RAIL SAWS,
TURN-TABLES,
TRANSFER TABLES,
FREIGHT CONVEYORS.

NEW YORK AGENCY, OFFUTT & CO., Cor. Church & Rector Sts.
CHICAGO AGENCY, L. M. SLACK 411 Phenix Building.

M. BEATTY & SONS,

WELLAND, ONTARIO.

Dredges, Ditchers, Derricks, Steam Shovels,

HOISTING ENGINES,

Horse-Power Hoisters, Gang Stone Saws and Stone Derrick Irons.

Centrifugal Pumps and other Contractors' Plant.

BOOTH BROTHERS AND HURRICANE ISLE GRANITE CO. OF NEW YORK.

Incorporated under the Laws of the State of New York as a full Liability Company.

DIRECTORS:
WM. BOOTH, President.
JOHN BOOTH.
JOHN DONALDSON.
W. S. WHITE.
CHAS. S. FERGUSON

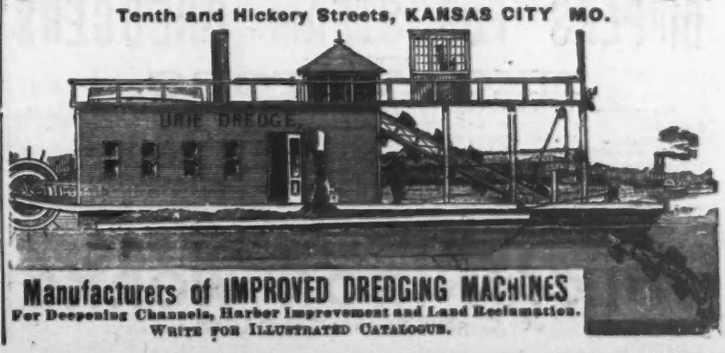
OFFICE, 60 Bank Street, New York.
CONNECTICUT OFFICE, New London.
MAINE OFFICE, W. S. WHITE (Manager), Rockland, Me.

QUARRIES:
Millstone Point, Niantic, Conn.
Hurricane Isle, Knox Co., Me.
Long Cove, Tenants Harbor, Me.
Atlantic, St. George, Me.
State Point, St. George, Me.
Granite Island, Vinal Haven, Me
Pequot, Vinal Haven, Me.

Estimates furnished for all kinds of building work and heavy masonry. Paving Block furnished in any quantity.

URIE DREDGE MANUFACTURING CO.

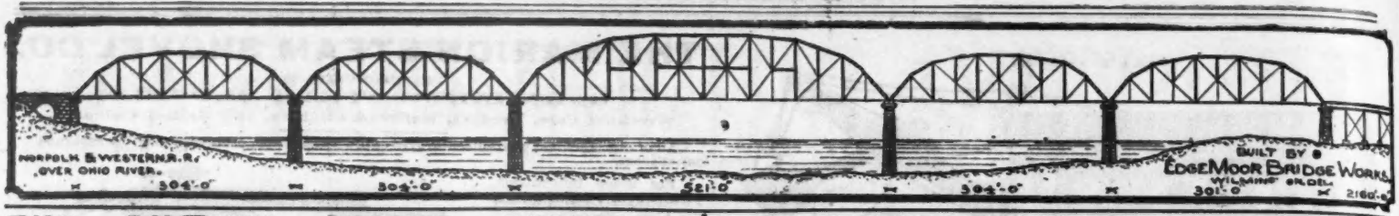
Tenth and Hickory Streets, KANSAS CITY MO.



Manufacturers of IMPROVED DREDGING MACHINES

For Deepening Channels, Harbor Improvement and Land Reclamation.

WRITE FOR ILLUSTRATED CATALOGUE.



THE PHŒNIX BRIDGE COMPANY,

Offices: 410 Walnut St., Phila.; 49 William St., New York; Phœnixville, Pa.
Chicago, Ill., 931 The Rookery, A. C. Stites, Engineer.

ENGINEERS AND BUILDERS OF

Bridges, Viaducts, Roofs, Turn-Tables, Elevated Railroads
OCEAN PIERS, and all Structures of Iron and Steel.

All work done on the premises—from ore to finished bridge.

Capacity of Bridge Works, 40,000 Tons per Annum.

The attention of officers of Railway Companies is called to our illustrated "Album of Designs," showing the various styles of Iron and Steel Railway Bridges, Viaducts, etc., that we have constructed and are prepared to construct, and containing our "Standard Specifications," which we will mail to any person requiring such structures.

Estimates and special designs will be furnished on application

DAVID REEVES, Pres. — ADOLPHUS BONZANO, Vice-Pres. and Chief Eng.
WM. H. REEVES, Gen. Supt — FRANK T. DAVIS, Treas.

BOSTON BRIDGE WORKS.

D. H. ANDREWS, Proprietor. — 70 KILBY ST., BOSTON MASS.

DESIGNERS AND BUILDERS OF

Railroad Bridges and Heavy Wrought Iron Structural Work

OF EVERY DESCRIPTION.

SUPERIOR WROUGHT IRON TURNTABLES A SPECIALTY.

Works on Grand Junction Railroad.

SOOYSMITH & COMPANY, CONTRACTING ENGINEERS,

MAIN OFFICE: 2 NASSAU STREET, NEW YORK,

Plant Always Ready to Build in Any Part of the Country,

BRIDGE PIERS,

Pneumatic Caisson Foundations, Tunnels, Marine Piers, Docks, Light-houses, Etc. The Freezing Method

Now in use by us, and for which we control the American Patents, make the construction of Subaqueous Tunnels, Deep Foundations, Shafts, Etc., practicable in soft or water-bearing ground. and to depths hitherto unattainable.

Among the Works Built by Us are the Piers and Foundations for the Following Large Bridges:

Over the Mississippi River,	at	Ft. Madison, Ia.,	for the	Santa Fe System.
" " "	"	Keithsburg, Ill.	"	Central Iowa Ry.
" Missouri River	"	Kansas City, Mo.,	"	Chi., Milwaukee & St. Paul Ry.
" " "	"	Sibley, Mo.,	"	Santa Fe System.
" " "	"	Glasgow, Mo.,	"	Chicago & Alton R. R.
" Susquehanna Riv.	"	Havre de Grace, Md.,	"	Baltimore & Ohio R. R.
" Ohio River	"	Cincinnati, O.,	"	Huntington System.
" Red River	"	Gainesville, Tex.,	"	Santa Fe System.
" Colorado River	"	Needles, Cal.,	"	Santa Fe System.
" Ohio River	"	Louisville, Ky.,	connecting	Jeffersonville, Ind.
" Missouri River,	at	Omaha, Neb. }	NOW IN PROGRESS.	
" " "	"	Sioux City, Ia. }		

W. C. LIVENGOOD,

CONTRACTOR.

Bridge and Trestle Work, Docks, Buildings, Erection of Iron Work, Etc.

DESIGNS FURNISHED IF REQUIRED.

Office, 328 Chestnut St., Room 57, Philadelphia, Pa.

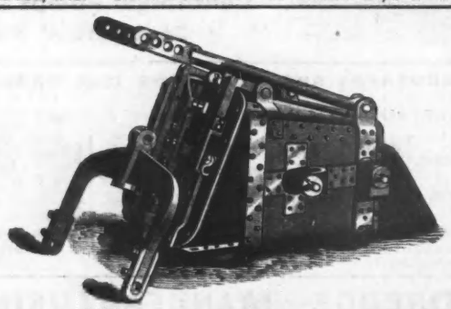
WISCONSIN BRIDGE & IRON CO.,

MILWAUKEE, WIS.

RAILROAD AND HIGHWAY BRIDGES,

ROOFS AND STRUCTURAL IRON.

Works at WAUWATOSA, WIS. Southern Office: 413 East Houston St., SAN ANTONIO, TEXAS.



DIPPERS FOR STEAM DREDGERS

—AND—

EXCAVATORS.

We make our Dippers from **carefully prepared drawings**, and not by the eye of the blacksmith, as was formerly the custom. Due attention is paid to strength of lugs, sizes of pins, weight of arms and braces, and good proportions throughout.

All the sheets are made of steel. All holes for fastening on bands and lugs are drilled. Burden's best rivets are used. All pin-holes are machine finished. All the pins are of Ulster iron, the idea being to have the pins wear before the other parts. Much care is taken to get a good taper, so as to allow free dumping. The latches on the doors of the smaller dippers have an improved spring bolt. The bail is furnished with top and end clevises, as shown in cut, which, when worn, can be readily replaced, and thus save loss of time.

When dippers are required to fit old arms and bails, these dimensions should be sent us. When ordering dippers or requesting prices, we would like to know for what class of work they are to be used, as we make them light or heavy, and with long and short mouth-pieces.

VULCAN IRON WORKS,

86 N. Clinton Street, CHICAGO, ILL.

MO. VALLEY BRIDGE & IRON WORKS.

LEAVENWORTH KAN

A. J. TULLOCK Prop.

MFRS. AND BUILDERS OF

Wrought Iron, Steel, Howe Truss and Combination Bridges, Turn Tables, Draw Spans, Roof Trusses. Piers, Substructures, Foundations, Etc., Etc.

L. M PITKIN, *President.* — F. L. CHAMBERLIN, *Secretary.* — H. P. HEPBURN, *Eng. & Gen. Agt.* — C. F. LEWIS, *Eng. of Con.*

THE VARIETY IRON WORKS CO.,

WORKS NO. 1. 51 to 73 Scranton Ave. — CLEVELAND, OHIO. — WORKS NO. 2. Hamilton St. near Case.

MANUFACTURERS OF

Steel and Iron Bridges, Roofs, Turntables, Buildings and Structural Iron Work

Chester B. Albree.
IRON RAILINGS
WROUGHT IRON FORGINGS
IRON TRUSS BRIDGES
IRON BUILDINGS
IRON STAIRWAYS
BRIDGE • RAILINGS.
SEND FOR CATALOGUE & PRICE LISTS OF CONTINUOUS STYLE.
EVERY CITY, COUNTY & BRIDGE ENGINEER SHOULD OWN A COPY.
NOS. 14 TO 30 MARKET ST. ALLEGHENY, PA.

THEO. KANDELER, 206 La Salle St., Chicago,

ENGINEER AND CONTRACTOR.

BRIDGES AND BUILDINGS.

THE KING BRIDGE COMPANY.

Iron and Steel Bridges, Girders, Turntables, Buildings, Eye Bars, Elevated Railroads and Structural Work of all kinds.

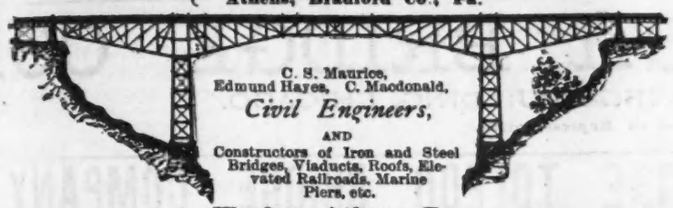
OFFICE AND WORKS: CLEVELAND, OHIO.

CHICAGO OFFICE: 1105 & 1107 THE ROOKERY BUILDING.
NEW YORK OFFICE: 520 WELLES BUILDING 18 BROADWAY

CAPACITY, 20,000 TONS PER ANNUM.

UNION BRIDGE CO.,

OFFICES: { No. 1 Broadway, New York. 24 Hayen Building, Buffalo, N. Y. Athens, Bradford Co., Pa.



C. S. Maurice, Edmund Hayes, C. Macdonald, *Civil Engineers*, AND Constructors of Iron and Steel Bridges, Viaducts, Roofs, Elevated Railroads, Marine Piers, etc.

Works: Athens, Pa.

Chas. Kellogg, *Prest.* Robt. Grimes, *Vice Prest.* Walter Hawxhurst, *Treas.* W. S. McCord, *Secy*

ELMIRA BRIDGE CO.,

(LIMITED.)

ENGINEERS AND MANUFACTURERS.

Steel and Iron Bridges, Roofs & Turntables.

ELMIRA, N. Y.

OFFICE & WORKS: ELMIRA, N. Y.

NEW YORK OFFICE: 18 BROADWAY

HENRY W. OLIVER, President. A. L. SCHULTZ, C. E., Vice-President. O. G. SCHULTZ, Secretary and Treasurer.

SCHULTZ BRIDGE & IRON COMPANY,

PITTSBURG, PA.

WESTERN OFFICE: PHIL W. HERZOG, Monon Block, 322 Dearborn St., Chicago, Ill.

GENERAL OFFICE AND WORKS: Chartiers Station, Pitts. & Lake Erie Ry., Allegheny Co., Pa.

SHIFFLER BRIDGE COMPANY,

MAIN OFFICE AND WORKS: FORTY-EIGHTH STREET and A. V. R. R. —PITTSBURGH, PA.—

BRANCH OFFICES: EDWIN THACHER, Consulting Engineer, 258 W. Main Street, Louisville, Ky. OLAF HOFF, Consulting Engineer, 602 Oneida Block, Minneapolis, Minn.

PENNSYLVANIA STEEL COMPANY,

Iron or Steel Bridges, Girders, Buildings, Roofs.

Address BRIDGE AND CONS. DEPT., PENNSYLVAN L COMPANY, STEELTON, PA.

WROUGHT IRON BRIDGE CO.,

Iron and Steel Bridges, Girders, Turn-Tables, Buildings and Structural Work.

OFFICE AND WORKS: CANTON, OHIO.

A. & P. ROBERTS & COMPANY.

PENCOYD IRON WORKS,

MANUFACTURERS OF

WROUGHT IRON AND OPEN HEARTH STEEL.

OFFICE: 261 S. 4th Street, PHILADELPHIA, PA.

PENCOYD BRIDGE & CONSTRUCTION COMPANY,

DESIGNERS AND MANUFACTURERS OF

BRIDGES, VIADUCTS, TURNTABLES, Etc.

WORKS: PENCOYD, PA.

AMERICAN BRIDGE & IRON COMPANY.

OFFICE AND WORKS:

ROANOKE, VA.

S. WALTON, President. CHAS. C. WENTWORTH, Engineer.

HORACE E. HORTON, President. A. M. BLODGETT, Vice-President. W. B. WHEELOCK, Secretary. G. H. WHEELOCK, Treasurer.

CHICAGO BRIDGE AND IRON COMPANY,

CITY OFFICE: No. 443 ROOKERY BUILDING.

CHICAGO, ILL.

OFFICE AND WORKS: ROCK ISLAND AND PANHANDLE RY'S 106th and 106th Streets. (WASHINGTON HEIGHTS, P. O.)

W. H. FITCH, Prest. HANK CONGER, Vice-Prest. B. R. WILLIAMS, Secy. C. W. CONGER, Treas. E. A. LANDON, Engr.

Groton Bridge & Manfg. Co.,

BUILDERS OF

RAILROAD AND HIGHWAY BRIDGES

Viaducts, Girders, Roof Trusses, Turntables, Iron Wharfs, etc. Die-Forged Eye-Bars and Upset Rods a specialty.

Main Office and Works, GROTON, N. Y.

AMES NEILSON, President. L. E. COCHRAN, Vice-Prest. J. P. KENNEDY, Gen'l Manager. W. L. COWLES, Chief Engineer B. F. BOYD, Sec'y and Treas.

THE YOUNGSTOWN BRIDGE CO.,

—MANUFACTURERS OF—

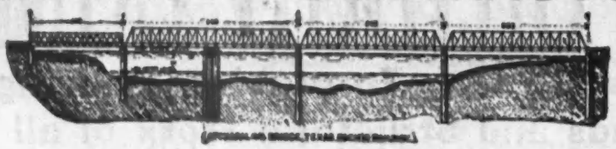
IRON AND STEEL BRIDGES,

Roofs, Turntables and Structural Work,

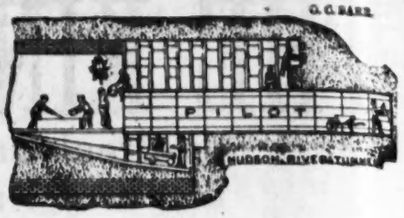
A. P. ANDERSON.

AUTOMATIC DREDGE FOR DIGGING TUNNELS.

ANDERSON & BARR,
ENGINEERS AND CONTRACTORS.



G. G. BARR.



SPECIALTIES

Pneumatic Work, Deep Foundations and Tunneling in Soft Materials.

CONTROL THE PATENTS FOR THE AUTOMATIC DREDGE AND ANDERSON SYSTEM OF TUNNELING.

Address 240 11th STREET, JERSEY CITY, N. J.

THE PITTSBURGH BRIDGE CO.

WESTERN OFFICE, 1105 OWINGS BUILDING, CHICAGO.

W. W. CURTIS, Western Representative.

A. J. SPRAGUE, Pres. Toledo, O. W. C. JACOBS, Secy. & Treas. Massillon, O. J. H. HILTON, Engineer Massillon, O.

THE MASSILLON BRIDGE CO.,

Works and Main Office: MASSILLON, O.

Iron, Steel and Wood Railroad and Highway Bridges and Structural Iron Work.

Toledo Office: Darst Block, Adams Street. Chicago Office: Calumet Building, Lasalle St.

CARL BINDER. MAURICE SEIFERT

BINDER & SEIFERT,

CONTRACTORS AND CONSULTING ENGINEERS.

WOODEN, COMBINATION, IRON AND STEEL BRIDGES, VIADUCTS ROOFS, BUILDINGS AND FOUNDATION WORK.

Room 803 Royal Insurance Building, 169 Jackson St., Chicago, Ill.

WATTS COOKE, *President.* W. O. FAYERWEATHER, *Treasurer.* G. H. BLAKELY, *Engineer*

PASSAIC ROLLING MILL COMPANY,

Works at PATERSON N. J. New York Office, 45 Broadway.

BRIDGE BUILDERS.

Wrought Iron and Steel Railroad and Highway Bridges, Viaducts, Roofs, Depots, Turntables, Elevated R. R., etc.

Manufacturers of all kinds of Iron and Steel Work for Bridges and Buildings. Plans and Estimates furnished.

POTTSVILLE IRON & STEEL CO.,

MANUFACTURERS OF

Open-Hearth Steel and Iron "I" Beams, Channels, Tees, Angles, Bars, and Buckle Plates.

ALSO

BUILDERS OF BRIDGES, ROOFS, VIADUCTS, TURNTABLES,

And all kind of CONSTRUCTED WORK of STEEL and IRON.

Office: NO. 226 SOUTH FOURTH STREET, PHILADELPHIA, PA.

WORKS, POTTSVILLE, PA.

T. C. SNYDER, Prest. H. P. BALL, Sec'y. JAS. H. RICHARDSON, Treas.
CLIFFORD HOLBROOK, Vice-Prest. T. C. BELDING, Supt.

ESTABLISHED 1877.

THE CANTON STEEL ROOFING CO.,

MANUFACTURERS OF

Patent Steel Roofing, Corrugated Iron, Etc.

PATENT EAVE TROUGH, CONDUCTOR PIPE, ETC.

CANTON, O.

RAILWAY SURVEYS AND RE-SURVEYS.—By Hosea Paul, Ch. Engr. Toledo & Western Ry. This valuable article extends through ENGINEERING NEWS for Sept. 12, 19 and 26, 1891, and it is "a veritable photograph, a living picture of the line" of the railroad re-surveyed. Invaluable for chief engineers of railroads, for its suggestiveness, and for young engineers who hope to become chiefs it is even more valuable. Price, 45 cents for the set, and as soon as edition is exhausted it will be out of print completely.

ARMOR PLATE TESTS AT THE GOVernment Proving Ground at Indian Head, Md.—These important tests were reported by a special correspondent for ENGINEERING NEWS, who was also allowed to photograph the results on the spot and at once. These illustrations are given in ENGINEERING NEWS, Nov. 28, 1891. Price, 15 cents.

A Treatise on Hydraulic and Water Supply Engineering.

By J. T. FANNING, Consulting Engineer, Minneapolis, Minn.

The most complete theoretical and practical treatise yet published on these subjects; written by an engineer of large experience in designing and the construction of public works. Ninth Edition. 8vo, 675 pages, 200 illustrations, many new formulas. Price, $5.00. For sale by ENGINEERING NEWS PUBLISHING CO.

Osborne's Working Plans of Railway and Highway Structures.

DIMENSIONS, QUANTITIES AND COST

PRICE, $5.

R. B. OSBORNE & SON,

302 Walnut St., Philadelphia, Pa

THE TOLEDO BRIDGE COMPANY,

Successors to THE SMITH BRIDGE COMPANY,

TOLEDO, OHIO,

RAILROAD AND HIGHWAY BRIDGES

R. P. & J. H. STAATS,

ENGINEERS AND CONTRACTORS.

Docks, Bridges, Trestles, Buildings

29 BROADWAY, NEW YORK.

THEODORE COOPER,

Consulting Engineer,

No. 35 BROADWAY, NEW YORK.

Bridges, Elevated Railroads, Station and Shop Buildings, Piers, Ferry Houses, or other structures. Foundations. General or detail plans, estimates, specifications, and superintendence of construction. Reports made upon existing or proposed structures.

DANIEL R. COFRODE. LOUIS P. EVAN

COFRODE & EVANS,

Engineers and Contractors.

DESIGNS FURNISHED IF REQUIRED.

Railroad Bridges & Trestle Work. Mill & Factory Buildings, Etc

S. E. CORNER FOURTH AND WALNUT STS., PHILADELPHIA, PA.

F. W. BARKER, Pres. PAUL WILLIS, Sec. and Engr.

Kenwood Bridge Co.

Builders of Bridges, Viaducts and all kinds of Steel and Iron Structures. Roof Trusses and Iron Buildings a Specialty.

OFFICE, 614 FIRST NATIONAL BANK BUILDING, CHICAGO.
WORKS, GRAND CROSSING, ILL.

R. A. SHAILER. C. R. SCHNIGLAU

SHAILER & SCHNIGLAU,

Successors to W. G. COOLIDGE & Co. ENGINEERS AND CONTRACTORS Designers & Builders of

BRIDGES, BUILDINGS AND SUBSTRUCTURES

Rooms 609, 610, 611 Phenix Building, 138 Jackson St., Chicago, Ill.

CHAMPION BRIDGE CO.,

WILMINGTON, O.

Iron and Steel Bridges.

VIADUCTS, SUBSTRUCTURES AND STRUCTURAL IRON WORKS

S. W. FRESCOLN,

ENGINEER & CONTRACTOR

World Building, New York.

Bridges, Iron and Steel Structures, Pneumatic Foundations, Tunnels, Docks, Subaqueous and Harbor Work Water-Works, Sewerage, Steam, Electric and Cable Railways.

"BOSTON" HOISTING ENGINE.

Over 2,500 in Use.

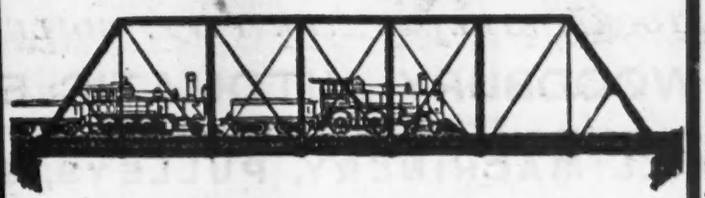
Single or Double Drum, for Builders, Contractors, Railroads and Quarries.

SOLE MANUFACTURERS,
PARKER, FIELD & MITCHELL,
23 Main St., Cambridgeport, Mass.

THE MT. VERNON BRIDGE CO.,
Iron & Steel Bridges, Buildings, &c
MT. VERNON, O.

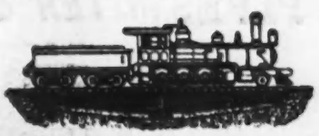
Jos. H. COFRODE — FRANCIS H. SAYLOR

Philadelphia Bridge Works.



COFRODE & SAYLOR,
CIVIL ENGINEERS AND
BRIDGE BUILDERS

WORKS: POTTSTOWN PENNA.



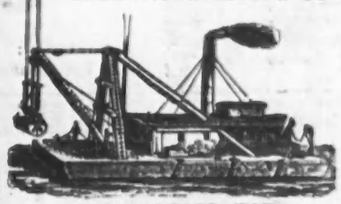
OFFICE: 257 S. Fourth St., PHILADELPHIA PENNA.

HOISTING ENGINES

Of any power and style, SINGLE AND DOUBLE CYLINDER, with improved patent friction drums especially adapted for all classes of work. Single and Double Drum, friction and direct geared, link motion MINING Engines. Four, six and eight spool, lock clutch, self-propelling BRIDGE ERECTING Engines. Double cylinder, double friction drum DOCK BUILDING and PILE DRIVING Engines. Quick motion, friction geared COAL HOISTING Engines. Powerful compound geared, reverse link motion and friction geared QUARRY Engines. WITH OR WITHOUT BOILERS. Any amount of reference given. Established 1870.

J. S. MUNDY, 22 to 34 Prospect St., Newark, N. J.

ATLANTIC DREDGING CO



CONTRACTORS FOR
RIVER & HARBOR IMPROVEMENTS
31-33 PINE STREET NEW YORK

F. J. McCAIN & BRO., Contractors for the Erection of IRON BRIDGES, BUILDINGS, ROOFS and VIADUCTS

ROOM 431 THE ROOKERY, CHICAGO, ILL.

HEXAGONAL TURNBUCKLES.

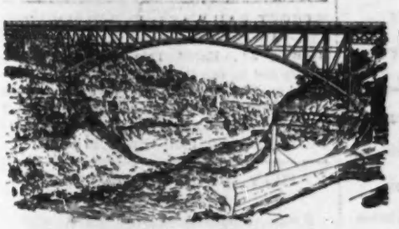
Guaranteed stronger than any buckle on the market. Only buckle made that has a perfect wrench hold.

Western Agt. { W. L. GREEN & CO., 46 Lake St., Chicago, Ill. } CENTRAL IRON & STEEL CO., BRAZIL, IND.

Bouscarens Specifications of Iron and Steel Railroad Bridges, 25 cent

Bouscaren's Specifications of Iron and Steel Highway Bridges, 25 cent

ROCHESTER BRIDGE & IRON WORKS,



DESIGNERS & BUILDERS OF
Wrought Iron & Steel Railway BRIDGES.

Both permanent and draw spans; also Elevated Railroads, Iron Viaducts, Piers, Turn Tables, Plate Girders, Roofs, Tanks & General Iron Work for Buildings; also Continuous Riveted Wrought Iron Pipe with Expansion Joint.

CAPACITY OF WORKS
1,500 TONS PER MONTH

JOHN F. ALDEN, Proprietor, Rochester, N. Y.

American Hoist and Derrick Co.

St. Paul, Minn.,
AND
48 S. Canal St.
Chicago.

ALFRED J. MURRAY
TIMBER, PILES, DOCK LOGS,
AND SPARS.
16 BEAVER STREET, NEW YORK.
Telephone and Telegraph Poles a specialty
Telephone No. 2963 Cortlandt.

ADVERTISE CONTRACT WORK IN ENGINEERING NEWS.

The Standard Book on Irrigation

Irrigation Canals and Other Irrigation Works, including the Flow of Water in Irrigation Canals and Open and Closed Channels Generally, with Tables Simplifying and Facilitating the Application of the Formulæ of Kutter, D'Arcy & Bazin. By P. J. FLYNN, C. E., San Francisco, Cal., 1892. Price $8. 2 vols., bound together. 665 pages. For sale by Engineering News Publishing Co.

THE ELECTRIC RAILWAY IN THEORY AND PRACTICE.—By O. T. Crosby and Louis Bell, 8vo. 389 pages. New York, 1892. Price, $2.50. Now that electricity is rapidly driving out all other methods of street car propulsion, a really good treatise, such as this is very timely. It is the only book on the subject worthy of mention, and it is for sale by Engineering News Publishing Co., Tribune Building, N. Y. City.

Old Dominion Creosoting Works,

Norfolk, Va., Office 59 Main Street.
Yellow pine timber of all dimensions Cross Ties and Piling Creosoted with
DEAD OIL OF COAL TAR
By process approved and accepted by U. S. Government Engineers.
Orders Solicited.

THE LEHIGH VALLEY
CREOSOTING WORKS.

H. Stanley Goodwin, Pres. Walter G. Berg, Eng. H. Comer, Supt.
Works: PERTH AMBOY, N. J.
Lumber, Piling and Ties creosoted with DEAD OIL OF COAL TAR. Creosoted timber furnished. Capacity, 400,000 feet B. M. per month. Cylinders 80 feet long. Direct Rail and Water Communication. Office Washington St., Jersey City, N.

Hon. WARNER MILLER, President. WM. KENNISH, Engineer and Superintendent.

CAROLINA OIL & CREOSOTE WORKS.

THE CAROLINA OIL & CREOSOTE CO. are the largest manufacturers of CREOSOTE OIL in the world.

Specially adapted for the preservation of Bridge Timbers, Cross Ties and Underground Conduits. Creosoted Piles and Lumber of all kinds furnished. Creosote Oil sold by the barrel, carload or cargo. Shipment by rail or water to all points. Address

CAROLINA OIL AND CREOSOTING COMPANY, WILMINGTON, N. C., U. S. A.

VANDERBILT & HOPKINS
Lumber Manufacturers.
RAILROAD TIES
to order. Railroad Supplies, White and Yellow Pine, Oak, Cypress, Spruce and Hemlock Plank. Creosoted Lumber, Timber and Piles. Dimension Lumber Sawed to order.
120 LIBERTY ST., NEW YORK

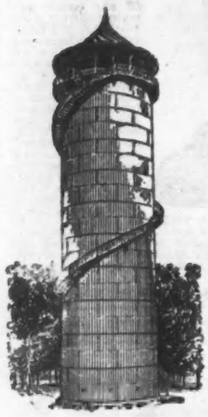
THE EPPINGER & RUSSELL CREOSOTING WORKS,

FIRST STREET AND NEWTOWN CREEK, LONG ISLAND CITY.

GEO. S. VALENTIN Manager. New York Office, No. 160 Water Street. PRACTICAL EXPERIENCE SINCE 1872

SOLE AGENT FOR THE MACDONALD ELECTRICAL SUBWAY CONDUIT.

Timber Creosoted by our Improved Process. Creosoted Piles, R. R. Ties and Timber of all kinds furnished. Bridge Timber a specialty. Introduced in 1888, and up to date Dead Oil of Coal Tar is the only known product that will preserve timber for all purposes. Approved by the Committee on the Preservation of Timber of the American Society of Civil Engineers. We use only the best Dead Oil of Coal Tar, which prevents decay and the ravages of marine and other insects and adds strength to the Timber.
This is the Largest Creosoting Plant in the World, consisting of four cylinders 140 ft. long, with all necessary pumps, boilers, superheaters, hoisting engines, derricks, cars, etc. All modern improvements. Capacity, 50,000 ft. in 24 hours; 600 ft. dock front, with 21 ft. water. Railroad and Cartage Facilities.
Specimens of Creosoted Paving Blocks laid in Galveston in 1878 treated by Geo. S. Valentine and sections of other Timber at New York office. Information and references furnished.



STAND-PIPES.

PENSTOCKS, STEEL WATER PIPE, BOILERS, TANKS, ETC.

WOODBURY AUTOMATIC ENGINES,

Simple and Compound, Medium and High Speed.

SAW MILL MACHINERY, PULLEYS, SHAFTING, ETC.

STEARNS MFG. CO., ERIE, PA.

CHICAGO: 1120 The Rookery | PHILADELPHIA: 944 Drexel Building. | NEW YORK: 136 Liberty Street. | SAN FRANCISCO: 29 and 31 Spear Street.

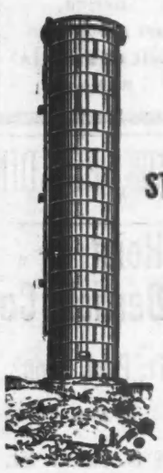
U. S. WIND ENGINE & PUMP CO.

BATAVIA, ILL., U. S. A.

Water Tanks.
Elevated Reservoirs,
Stand-Pipes,
Wind Engines
Steam Pumps,
General Water-Works Contractors.

Plans and Specifications Furnished.

STAND PIPES,



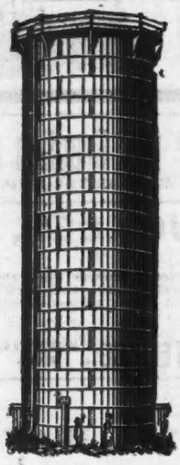
TANKS,
STEAM BOILERS
Etc., Etc., Etc.

BUILT BY

E. HODGE & CO.,
East Boston, Mass.
BOSTON OFFICE:
Room 72, Mason Building. 12 to 2.

RITER & CONLEY,

MANUFACTURERS AND BUILDERS OF



Iron Buildings,
Boilers,
Oil Tanks,
Stand Pipes,
Plate Iron Girders,
Corrugated Iron and all kinds of Heavy Plate Iron or Steel Work for Blast Furnaces, Steel Works or Rolling Mills.

55 & 56 Water Street,
PITTSBURGH.

We have erected

STAND PIPES

At the following places:

Kankakee, Ill.	20 x 124
Cornwall, Ont.	20 x 120
Salisbury, N. C.	20 x 100
Washington, Ind.	20 x 100
Beaver Dam, Wis.	20 x 84
Waterford, N. Y.	30 x 52
Berwick, Pa.	11 x 45
Homer, N. Y.	25 x 40
Cobourg, Ont.	16 x 116
Marshall, Mich.	20 x 100
Hamburg, N. Y.	16 x 125
Canton, N. Y.	20 x 72
Rhinelander, Wis.	20 x 65
Fort Smith, Ark.	30 x 100

Sharon Boiler W'ks
(Limited)
SHARON, PA.

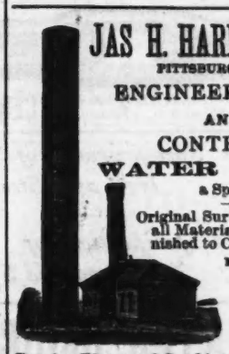
JAS H. HARLOW & CO.,

PITTSBURGH, PA.,

ENGINEERS AND CONTRACTORS.

WATER WORKS a Specialty.

Original Surveys Made, and all Material and Labor, furnished to Completion.



MANUFACTURERS LETZKUS TAPPING MACHIN for Tapping Water and Gas Lines under pressure

---

TIPPETT & WOOD

BUILDERS OF

IRON BRIDGES,
TURNTABLES,
STAND-PIPES,
WATER TOWERS,
STEAM-BOILERS,
DIGESTORS,
TANKS,
STACKS, ETC.
GENERAL CONTRACTORS IN IRON-WORK.

Phillipsburg, New Jersey.

Holmes' Flexible Joint.

I have perfected and patented the best flexible joint for water pipes, gas pipes, steam pipes, compressed air pipes, oil, etc., etc., for use with either cast or wrought pipe, flanged, head or screw joints, easily attached and detached, and by its use pipes can be connected at any angle without trouble and with the least amount of friction possible. It will allow of more movement in any direction than any other joint without leaking, and is very reasonable in price.

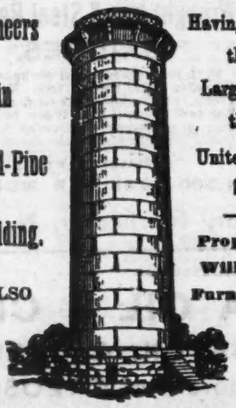
Correspondence solicited.

A. L. HOLMES,
Grand Rapids, Mich.

Cunningham Iron Works Company,

Congress St. cor. of B., South Boston, Mass.

Pioneers in Stand-Pipe Building.



Having Built the Largest in the United States.

Proposals Willingly Furnished.

ALSO

Steam Boilers and General Iron Work.

STREET RAILWAYS; EUROPEAN PRACTICE.—An elaborate report by Mr. Osborne Howes, Jr., Rapid Transit Commissioner, submitted to the Boston Rapid Transit Commission, Nov. 10, 1891, on the transportation of passengers in and around the cities of Europe. Published in ENGINEERING NEWS, Nov. 21, 1891. Price, 15 cents.

BUY your BOOKS from

Engineering News Pub. Co

THE TANSA DAM, BOMBAY, INDIA.—Said to be the longest masonry dam in the world; is 9,000 ft. long, 118 ft. high, 100 ft. wide, at bottom and 15 ft. 6 ins. on top. A very complete description, showing also profile and section, is published in ENGINEERING NEWS, June 30, 1892. Price, 15 cents.

ADVERTISE CONTRACT WORK IN ENGINEERING NEWS.

Best Pipe Covering and Fireproof.

BROWN'S KEYSTONE CEMENT.

REFERENCE: Pennsylvania Railroad.

President, Gen'l. W. W. H. DAVIS.
Secretary, L. A. WAINRIGHT PATTERSON.

Office, 46 BULLETT BUILDING, PHILADELPHIA, PA.

INDEX TO IMPORTANT ARTICLES IN BACK NUMBERS OF ENGINEERING NEWS.

We present herewith, and will continue to do so in succeeding numbers, a catalogue of articles which have been printed in Engineering News. There is a continual and growing inquiry for back numbers of the paper; sometimes it is for the sake of an article on some special subject being studied; very frequently it is to complete volumes the value of which are now being appreciated as the difficulty of securing them becomes greater. We may state right here that it is practically impossible to buy a complete set of Engineering News, and we know by experience that it is very difficult to complete any volume whatever.

In ordering, either give the number preceding the catalogued article, or cut out the paragraph and inclose in letter. The number if made up of four figures calls for 15 cts., if of more than four figures may be for 30, 60 or 90 cts., according to the number of papers it calls for. Cash must always accompany the order to secure attention. Postage stamps taken same as cash. We prepay all papers sent out through the mails.

2281. Artesian Well Practice in the United States. Illustrated by profile diagram.

2648. The Government Armor Plate Tests at the Indian Head Proving Grounds. Photographic Illustrations. Prepared by special representative of this journal who witnessed the tests.

2837. The Victoria Bridge at Stockton-on-Tees, England. Illustrated.

2844. Competitive Designs for a Drawbridge over the Duluth Ship Canal, Duluth, Minn. With inset.

2842. Chicago Buildings and Foundations. An address on the Sooysmith System of Building Construction for Chicago, by Gen. William Sooysmith. Illustrated, and Editorial.

2838. The Hawarden Bridge Over the River Dee, England. Illustrated. Abstract of a paper by Mr. F. Fox, M. Inst. C. E.

2835. A symposium of the Use of Steel for Railroad bridges.

THE DEANE STEAM PUMP COMPANY.

HOLYOKE, MASS.

WATER WORKS ENGINES.

Daily Pumping Capacity of Deane Water-works Engines in Service Over 500,000,000 Gallons.

OFFICES AND WAREROOMS:

NEW YORK,	CHICAGO,	BOSTON,	ST. LOUIS,	PHILALELPHIA,	DENVER,
72 Cortlandt Street.	226-228 Lake Street.	54 Oliver Street.	9 South Fourth Street.	49 North Seventh Street.	1710 Blake Street

WRITE FOR FULL ILLUSTRATED CATALOGUE.

THE FREEMAN FIRE CLAY CO.,

FREEMAN, JEFFERSON CO., O.,

MANUFACTURERS OF

STANDARD AND DOUBLE STRENGTH VITRIFIED SALT GLAZED

SEWER AND CULVERT PIPE,

Patent Jointed Flue Linings and Flue Pipe, Water and Electric Conduits, Paving and Furnace Bricks, and all Fire Clay Products.

Branch Office and Yard, - - CINCINNATI, O., Front & Butler Sts.

Works foot of LOOKOUT MOUNTAIN near "Blowing Spring," Walker Co. Georgia

Most Complete in Every Detail.

LSPC

Capacity equal to any simila Plant in the Sou

STANDARD, VITRIFIED AND SALT GLAZED

Sewer and Railroad Culvert Pipe.

Especially recommended for smoothness of inside surface and conformity to true circular shape

For Price List, Discount, &c., Address

LOOKOUT SEWER PIPE CO., CHATTANOOGA, TENN.

THE UNITED STATES FIRE CLAY CO.,

THE OHIO SEWER PIPE CO.

SINGLE AND DOUBLE STRENGTH

SEWER AND CULVERT PIPE

CHIMNEY TOPS AND FLUES

FIRE AND PAVING BRICK

ANNUAL CAPACITY, 10,000 CARS.

GEN'L OFFICES: 91-93 FIFTH AVE., PITTSBURG, PA.

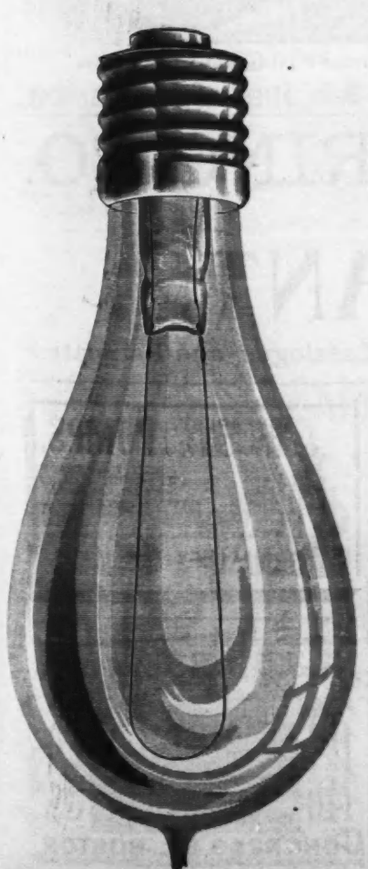
BRANCHES:

NEW YORK,	TORONTO, ONT.,	CHICAGO,
145 BROADWAY.	44 PRICE ST.	410 CHAMBER OF COMMERCE.

Advertise "Contract Work" in Engineering News.

GENERAL ELECTRIC COMPANY,

44 BROAD ST., NEW YORK CITY. 620 ATLANTIC AVE., BOSTON, MASS.



THE EDISON INCANDESCENT LAMP

Is the ONLY INCANDESCENT LAMP Lawfully Made.

All Others Infringe the Edison Patents and Are Counterfeits.

THE RIGHT OF THE EDISON COMPANY TO AN INJUNCTION AGAINST INFRINGERS HAS BEEN DETERMINED BY THE U. S. CIRCUIT COURT OF APPEALS.

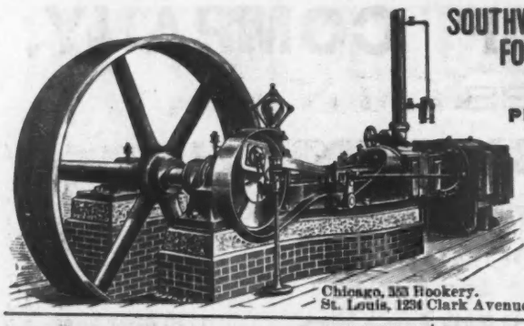
See decision of U. S. Circuit Court of Appeals in case of Edison Electric Light Company vs. United States Electric Light Company, decided Oct. 4, 1892.

See decision of U. S. Circuit Court of Appeals in case of Edison Electric Light Company and Edison General Electric Company vs. Sawyer-Man Electric Company decided Dec. 15, 1892.

Copies of these decisions will be sent on application.

BRANCH OFFICES:

620 Atlantic Avenue, Boston, Mass.
173 and 175 Adams Street, Chicago, Ill.
204 West Fourth Street, Cincinnati, O.
Gould Building, Atlanta, Ga.
44 Broad Street, New York.
500 Arch Street, Philadelphia, Pa.
15 First Street, San Francisco, Cal.
4[illegible]-407 Sibley Street, St. Paul, Minn
133 F Street N. W., Washington, D. C.
Masonic Temple, Denver, Colo.



SOUTHWARK FOUNDRY AND MACHINE CO.

Philadelphia, Pa.

SOLE MAKERS OF THE PORTER-ALLEN AUTOMATIC ENGINE

Simple, Compound or Triple Expansion.

ALSO BUILDERS OF

Blowing Engines, Reversing Engines, Centrifugal Pumps, Boilers, Tanks, Etc.

Chicago, 353 Rookery. St. Louis, 1234 Clark Avenue.

GOULDS PUMPS ARE BETTER.

This gives the reason for Goulds great Pump business, and the reason for you having Goulds Pumps in your business. They are more modern—more efficient—meaning more economical. For every service they are better. We put them in under definite guarantee as to the percentage of power, fuel and resultant loss which they will save. If you want to pump anything anywhere, please remember that Goulds Pumps afford the most efficient means of doing it. Special catalogues and further information given for the asking.

The Goulds Manufacturing Co.,

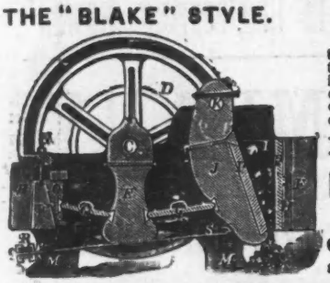
Manufacturers of Pumps and Hydraulic Machinery,

Factory, Seneca Falls, N. Y., U. S. A. Warerooms, 16 Murray St., New York.

Please mention this paper.

ROCK AND ORE BREAKERS OR CRUSHERS.

THE "BLAKE" STYLE.



This style of Rock Breaker after 15 years practical test at HOME and ABROAD has proved to be the BEST ever designed for the purpose of breaking all kinds of hard and brittle substances such as Quartz, Emery, Gold and Silver Ores, Coal, Plaster, Iron, Copper, Tin and Lead Ores. Also for making

Railroad Ballast and Concrete

FARREL FOUNDRY & MACHINE CO., ANSONIA, CONN.

Copeland & Bacon, Agents, New York and Chicago.

The Gordon Steam Pump Co.

HAMILTON, OHIO.

BRANCH OFFICES:

Pittsburg, 410 Lewis Block. | St. Louis, 703 Market St.
Cleveland, 30 So. Water St. | Tacoma, 1926 Pacific Ave.
Chicago, 42 & 44 So. Clinton St. | London, Hayward, Tyler & Co.

MANUFACTURERS OF

Water-Works and Sewerage Pumping Machinery

HORIZONTAL OR VERTICAL STEAM AND POWER PUMPS FOR ANY DUTY.

Prices and Full Information on Application.

Licensees for the Hill System of Condensation.

THE OHIO PAVING CO.,

GENERAL CONTRACTORS FOR STREET PAVING

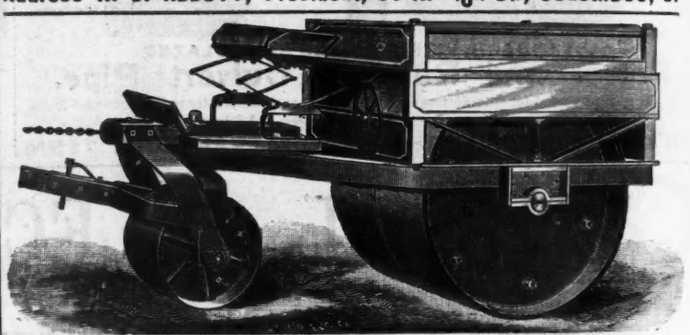
AND MANUFACTURERS OF THE

HALLWOOD PAVING BLOCK

Over 30 Miles of the Hallwood Block Laid in Columbus.
Over 10 Miles Laid in Other Cities.

Nearly as Durable as Stone, and Nearly as Smooth as Asphalt, While Much Cheaper than Either. Send for Pamphlet.

Address N. B. ABBOTT, President, 85 N. High St., COLUMBUS, O.



For Circulars of the Best Street Paving Rollers, Address

ENTERPRISE MFG. CO., 104 Main Street, Columbiana, Ohio.

THE BOUGHEN ENGINEERING CO.

ENGINEERS AND CONTRACTORS FOR STEAM AND

WATER-WORKS PLANTS.

CINCINNATI, O., U. S. A.

Write for Catalogue and Estimates

THE ONLY PUMP

For Water Works, Brick Yards, Quarries, Mines, Sewer Contractors, Foundation Builders, Farmers, all others who desire to raise large quantities of Water.

HAND POWER

PUMPS

The Most Powerful, Most Durable Largest Capacity, and Works the Easiest of any Hand Power Pump made. Low Priced.

Will pump water containing Sand, Gravel, Mud, Sewerage, Etc. *without choking* the Pump. In fact will pump water containing anything but rocks.

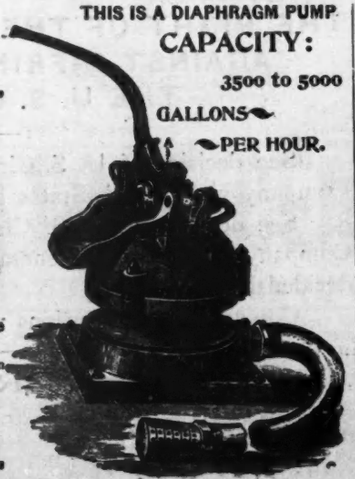
Full Information, Catalogue, Etc., Mailed Free. Write

BOSTON & LOCKPORT BLOCK CO., 162 Commercial St., Boston.

THIS IS A DIAPHRAGM PUMP

CAPACITY:

3500 to 5000 GALLONS PER HOUR.



CHEAPEST. HANDIEST. SIMPLEST. PUMPS.

Handling DIRTY, GRITTY and SANDY Liquids, without WEAR, OIL or CARE. Pumping Outfits for Contractors, Mining, Irrigating, Railroad, Quarry, Drainage and Manufacturing purposes. Second-hand Engines, Boilers, Pumps and other Machinery always on hand. Exchanging.

MASLIN'S 165-167 First St., Jersey City, N. J.

A. J. MORSE & SON.

DIVING APPARATUS

140 CONGRESS ST. BOSTON.

THE WORTHINGTON WATER METER.

In Use by the Water Companies of the United States and Canada for Over Forty Years, and Pronounced by Them

"UNEQUALED FOR ACCURACY AND DURABILITY."

ATTENTION IS CALLED TO THE FACT THAT THERE ARE

MORE WORTHINGTON METERS IN USE

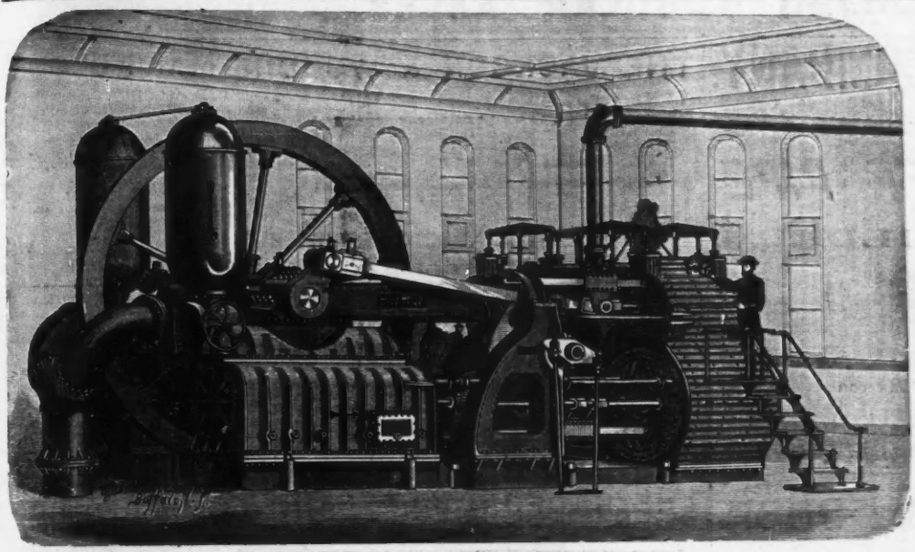
THAN THOSE OF ANY OTHER TYPE.

METERS FOR HOT WATER, CRUDE OIL, NAPHTHA, MOLASSES, ETC.

HENRY R. WORTHINGTON,

86 and 88 Liberty St., 145 Broadway, NEW YORK.

0 Kilby Street, BOSTON. 93 and 95 Lake St., CHICAGO. 607 Arch St., PHILADELPHIA.
404 and 406 Walnut St., ST. LOUIS. 1762 Larimer St., DENVER.



HOLLY MFG. CO.,

LOCKPORT, NEW YORK.

Two of These Engines Now in Course of Erection, Under a Cash Contract, for the Regular Supply of the

WORLD'S FAIR, CHICAGO,

Grounds and Buildings with Pure and Wholesome Water.

SEND FOR ILLUSTRATED PAMPHLET.

SEND FOR CATALOGUE

OVER 20000 IN USE

PULSOMETER BEST AND CHEAPEST STEAM PUMP KNOWN STEAM PUMP

FOR ALL PURPOSES

PULSOMETER STEAM PUMP CO. SOLE OWNERS-NEW YORK.

(COPYRIGHTED 1893.)

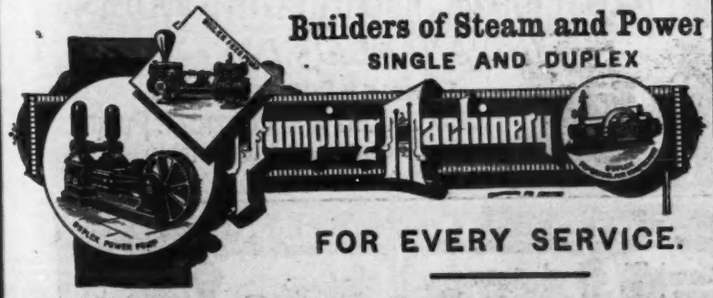
BUFFALO STEAM PUMP CO.,

STEAM PUMPS FOR ALL SERVICES
WATER-WORKS MACHINERY and INDEPENDENT CONDENSERS.

WORKS: Buffalo, N. Y.
Office & Warehouse, 76 John St. N.Y. City
Warerooms:
55 and 57 Clinton St., Chicago, Ill.

KNOWLES STEAM PUMP WORKS,

Builders of Steam and Power
SINGLE AND DUPLEX

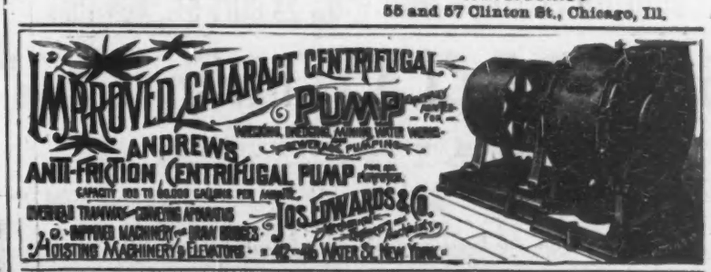


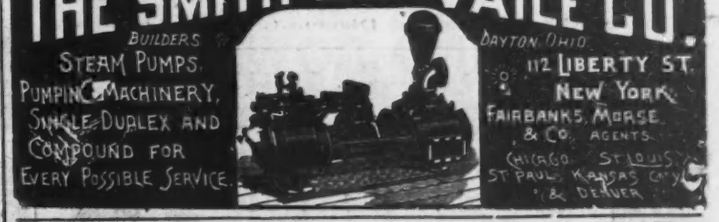
FOR EVERY SERVICE.

WATER-WORKS PUMPING ENGINES A SPECIALTY.

SEND FOR CATALOGUE.

113 Federal St., Boston. 3 Liberty St., New York.





THE BALDWINSVILLE CENTRIFUGAL PUMP.

The Oldest, Best and Cheapest Centrifugal Pump in the Market. Vertical, Horizontal and Suction Pumps. Capacity varying from 100 to 40,000 Gallons per minute. Address for Catalogue and Prices.

IRWIN VAN WIE, Manufacturer
48 and 52 West Street, SYRACUSE, N. Y.

SAND PUMPING OUTFITS A SPECIALTY.

Risdon Iron Works, San Francisco, Agent Pacific Coast

NATIONAL TUBE WORKS COMPANY.

McKEESPORT, BOSTON, NEW YORK, CHICAGO, ST. LOUIS, PHILADELPHIA.

WROUGHT IRON BOILER TUBES, LOCOMOTIVE TUBES--ALL QUALITIES.

WROUGHT IRON PIPE FOR COLUMNS.

KALAMEIN TUBES AND PIPE--WHICH WILL NOT RUST.

SEWERS, GAS PIPES, STEAM PIPES, SPECIAL PIPE AND COUPLINGS FOR WATER-WORKS.

PRODUCT, 500 TONS DAILY.

MACK'S PATENT INJECTOR FOR LOCOMOTIVES.

Dodge's Patent Injector for Stationary Boilers and Agricultural Machines.

SELF-OILING TUBULAR AXLES.

THE MICHIGAN PIPE COMPANY,

BAY CITY, MICH.,

MANUFACTURERS OF

IMPROVED WYCKOFF PIPE

—AND—

WATER-WORKS BUILDERS.

ESTIMATES MADE ON ALL KINDS OF PIPE WORK FOR

Water-Works, Railroads, Distilleries, Mines, Mineral Waters, Etc

Casing for Underground Steam Pipes.

Root's Water Tube Boiler.

ABSOLUTE SAFETY.

HIGHEST ECONOMY.

GREATEST DURABILITY.

Abendroth & Root Mfg. Co., 28 CLIFF ST., NEW YORK.

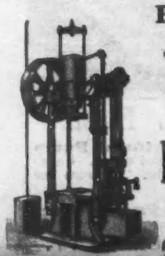
SHARON CLAY MFG. CO.,

SHARON, MERCER COUNTY, PA.,

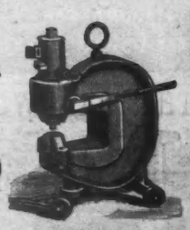
Manufacturers of Vitrified Salt Glazed Sewer Pipe and Hollow Brick or Building Blocks from Akron Shale.

For Price List, Terms and Discount, address as above.

HYDRAULIC MACHINERY,



PRESSES, PUMPS, PUNCHES,
JACKS, VALVES, FITTINGS,
PACKINGS, ACCUMULATORS.



Hydraulic Machinery Works,

WATSON & STILLMAN, Props.,

204, 206, 208 & 210 E. 43d St., New York.

THE JACKSON & WOODIN MAN'F'G CO.,

C. R. WOODIN, Prest.
C. H. ZEHNDER, Vice-Prest. and Gen. Manager.
WM. F. LOWRY, Treas.
FRED'K H. EATON, Secy.
H. F. GLENN, Gen'l Supt.

BERWICK, Columbia Co., Pa.

FREIGHT CARS, CAR WHEELS, BAR IRON.

SPECIAL CASTINGS.

GEO. MOERLEIN, Pres. JNO. GOETZ, JR., Vice-Pres. J. A. EBERHARDT, Sec.-Treas. & Gen. Man

THE SOUTHERN GRANITE CO.

ESTIMATES FOR ARCHITECTURAL, MONUMENTAL AND STREET PAVING WORK WILL BE PROMPTLY FURNISHED

OFFICES: 19 and 20 Wiggins Block, CINCINNATI, OHIO. | 20 Kimball House, ATLANTA, GA.

J. N. GAMBLE, Pres. M. C. ARMOUR, Vice-Pres. ARCHER BROWN, Treas. E. M. HINCHMAN, Secy. J. K. DIMMICK, Gen. Man. M. H. CRAWFORD, Cntg. Agt.

THE RADFORD PIPE AND FOUNDRY CO.

During 1892 The Radford Pipe and Foundry Co. supplied Pipe to Boston, Philadelphia, Baltimore, Syracuse; also Lowell, Fitchburg, West Newton, Mass., and numerous other Eastern cities, besides cities in the West, South and Northwest.

Works: Radford, Va.; Anniston, Ala. General Offices: Cincinnati, O.

HUGHES STEAM PUMP CO.,

—BUILDERS OF—

WATER-WORKS PUMPING ENGINES,

—AND—

General Pumping Machinery,

CLEVELAND, OHIO.

Dean Bros. Steam Pump Works,

INDIANAPOLIS, IND.

SINGLE & DUPLEX PUMPS.

HORIZONTAL AND VERTICAL PUMPS.

Best Design & Workmanship.

PRICES REDUCED Send for CATALOGUE.

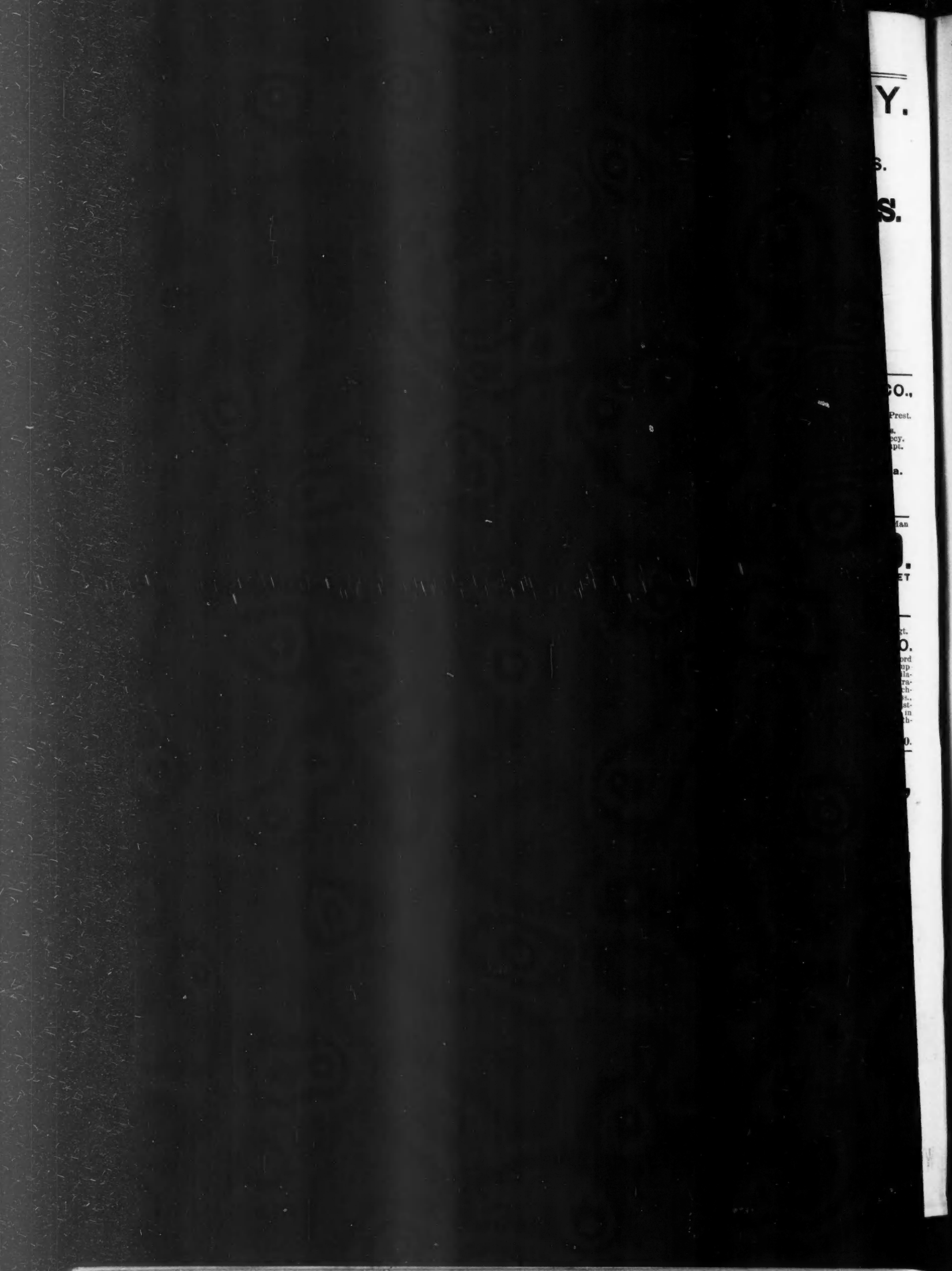
THE LAIDLAW & DUNN CO.

STANDARD COMPOUND STEAM PUMP.
STANDARD DUPLEX STEAM PUMP.
"HERO" BOILER FEEDER
PUMPS OF EVERY DESCRIPTION
CINCINNATI, O.
197 & 199 SO. CANAL ST. CHICAGO, ILLS.

T

H

C



THE ADDYSTON PIPE AND STEEL CO.,

CINCINNATI, OHIO.

HUB AND FLANGE PIPE, CULVERT AND SEWER PIPE.

SPECIAL CASTINGS, SEWER CASTINGS.

MACHINERY from your own designs.

Improved ROAD ROLLERS.

THE OHIO PIPE COMPANY,

MANUFACTURERS OF

FLANGE PIPE AND SPECIAL CASTINGS.

Heavy Castings a Specialty.

COLUMBUS, OHIO.

Sizes from Three to Thirty Inches in Diameter.

CAST IRON

PIPE

FOR WATER AND GAS.
BELL AND SPIGOT, OR FLANGED
WITH FITTINGS,

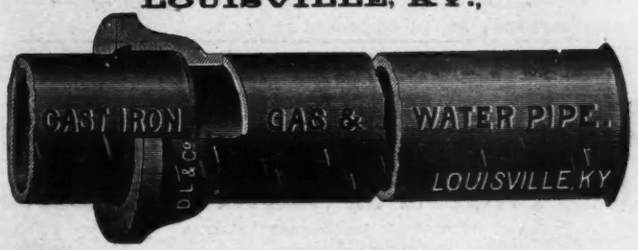
Fire Hydrants, Stop Valves, Lamp Posts, Canada Turbines, &c.
GENERAL FOUNDRY AND MACHINE WORK.

JOHN FOX Selling Agent, 160 Broadway, New York.

Mellert Foundry & Machine Co., Limited, READING PA.

DENNIS LONG & COMPANY,

LOUISVILLE, KY.,



MANUFACTURE EXCLUSIVELY

Cast-Iron Gas and Water Pipe

And SPECIAL CASTINGS of all sizes.

M. J. DRUMMOND,

SOLE SALES AGENT FOR

BUILDERS' IRON FOUNDRY "GLOBE" SPECIAL CASTING

Office, Corbin Building, 192 Broadway, N. Y.

George Ormrod Man. & Treas., Emaus, Pa. John Donaldson, Pres't, 136 South 4th St., Phila., Pa.

EMAUS PIPE FOUNDRY.

DONALDSON IRON CO.,

Manufacturers of CAST IRON PIPE and special castings for

WATER AND GAS.

ALL PIPES CAST VERTICALLY. EMAUS, LEHIGH CO., PA.

NATIONAL FOUNDRY & PIPE WORKS Limited.

MANUFACTURERS OF

FLANGE PIPE AND SPECIAL CASTINGS.

PITTSBURGH, PA., OFFICE:
402 and 403 Lewis Block.

SCOTTDALE, PA.

Warren Foundry and Machine Company.

WORKS AT PHILLIPSBURGH, N. J.

NEW YORK OFFICE, 160 BROADWAY.

CAST-IRON WATER AND GAS PIPE.

From three to forty-eight inches diameter. Branches, Bends, Retorts, Etc.

CHATTANOOGA FOUNDRY AND PIPE WORKS.

resident; C. B. IBESTER, Vice-President; M. LLEWELLYN, Sec. and Treas.

uccessors to D. GILES & CO., Chattanooga Tenn., Manufacturers of

Also CASTINGS and PATTERNS of every DESCRIPTION made to ORDER.

H. E. McWANE, Pres't & Gen'l Manager. W. D. CAMPBELL, Sec'y & Treasurer.

MANUFACTURERS' AGENTS FOR

WATER & GAS-WORKS SUPPLIES.

READING IRON COMPANY, Wrought Pipe, Tubes, and Special Work of every character.

CAST-IRON, WATER, GAS AND FLANGE PIPE, SPECIAL CASTINGS, Etc.

CHAPMAN VALVE MANUF'G CO., VALVES AND HYDRANTS.

Specifications for bids solicited and estimates of cost on all Engineering Work in iron given. Also on the specialities of the SCOTT FOUNDRY, such as Heavy Machinery, Boiler and Tank Work

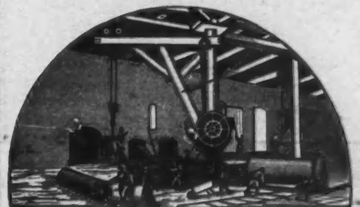
PANCOAST & ROGERS,

28 PLATT and 15 GOLD STREETS NEW YORK

A. H. McNEAL, Prest., Burlington, N. J. THEO. STURGES, Treas., New York.

The McNEAL PIPE & FOUNDRY CO.

MANUFACTURERS OF



CAST-IRON PIPE

FOR WATER AND GAS.

Large Cylinders and Heavy Castings.

General Foundry Work.

NEW YORK OFFICE, 52 Wall St. OFFICE AND WORKS Burlington, N. J

THE GLAMORGAN COMPANY,

CAST IRON GAS AND WATER PIPE.

Proprietors of the Hill City Pipe Works,

LYNCHBURG, VA.

O. M. BURKE, Pres. and Treas. C. E. BURKE, Vice-Pres., Supt. G. B. THOMAS, Sec'y

LAKE SHORE FOUNDRY

Manufacturers of all sizes of

Branch Castings Car Wheels, Locomotive, Car Bridge and General Casting

---

BARR PUMPING ENGINE CO.,

—MANUFACTURERS OF—

STEAM PUMPS,

GERMANTOWN JUNCTION, PHILADELPHIA.

NEW YORK: Street. CHICAGO: 32 Market Street. CLEVELAND: South Water Street.

NEW YORK ROSENDALE CEMENT COMPANY — ROSENDALE HYDRAULIC CEMENT — Office 280 BROADWAY (ROOM 71) NEW YORK.

"BROOKLYN BRIDGE" BRAND.

WARRANTED SUPERIOR TO ANY

Rosendale Hydraulic Cement Manufactured.

USED ON THE MOST IMPORTANT WORKS IN THE COUNTRY.

WM. C. MORTON, Sec'y.

SAYLOR'S Portland Cement — JOHNSON & WILSON AGENTS NEW YORK

SAYLOR'S PORTLAND CEMENT.

Strongest, Cheapest, Best, and Always Fresh.

For Sale by all Dealers in Masons' Materials.

JOHNSON & WILSON, Gen'l Agents,

Send for Pamphlets. 45 Broadway, New York.

WARREN SCHARF ASPHALT PAVING CO.,

WARREN-SCHARF ASPHALT PAVING COMPANY — 81 FULTON STREET, NEW YORK — TRADE MARK — GENUINE TRINIDAD ASPHALT

GENUINE

TRINIDAD ASPHALT PAVEMENTS

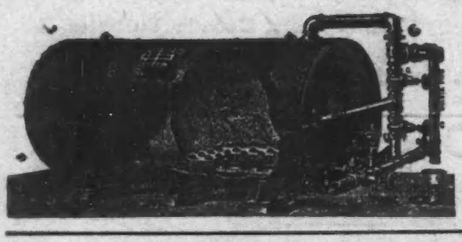
for Streets, Sidewalks, Driveways. The Standard Pavement for

Cheapness, Health, Durability, Smoothness and Safety.

IT ENHANCES THE VALUE OF PROPERTY MORE THAN ANY OTHER PAVEMENT.

Send for Circulars and Estimates.

Principal Office, 81 FULTON STREET, NEW YORK.



NEW YORK FILTER

Combining the best features of over 100 patents, including those of the well known **Hyatt, National, American** and **Blessing** type of Filters. Contracts made for Filters of any capacity. Satisfactory results guaranteed.

PRICES, ETC., FURNISHED UPON APPLICATION.

NEW YORK FILTER COMPANY, 145 Broadway, New York.

CHICAGO OFFICE, 85 DEARBORN STREET.

BEST QUALITY

TRINIDAD ASPHALT.

THE TRINIDAD ASPHALT REFINING CO.,

50 WALL STREET, NEW YORK.

"MACHINED" CAR WHEELS

600,000

MADE UNDER OUR

System of Comparative Tests without one Case of Breakage in Service.

We contract to regrind our wheels at points of removal, saving freight and increasing total life of wheels from 100 to 300 per cent.

New York Car Wheel Works, Buffalo, N. Y.

NEW YORK OFFICE: CORNER BANK & WEST STS.

American Portland Cements.

W. C. Whyte, Engineer and Contractor.

C. W. HARRIS, Esq., Agent for Lesley & Trinkle: NEW YORK, Feb. 21, 1889.

DEAR SIR: In reply to your inquiry as to the value of your American Portland Cement, I would say that I have used thousands of barrels of it, and I consider it superior for gas tank work, concreting especially, to any foreign cement I have ever tried. I believe this to be due to the great care in manufacture, and less liability to damage through sea voyage.

When able to procure your Cement I have always adopted it, finding it as I say better for my business than the foreign brands of Portland.

Yours truly, (Signed) W. C. WHYTE.

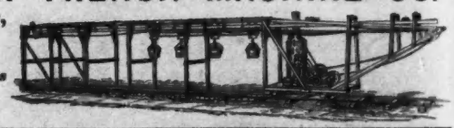
LESLEY & TRINKLE, Sales Agents,

220 South Third St., Philadelphia.

THE CARSON TRENCH MACHINE CO.

16 DORRANCE STREET, Charlestown District, BOSTON, MASS.

Trench Machines and Engines to Let for Digging and Back Filling Sewer and Water Trenches.



F. O. NORTON'S Cement was Used for Pointing.

F. Collingwood, Esq., Asst. Engr., writes:

"We used large quantities of your Cement in pointing the masonry of the East River Bridge, and always with satisfactory results, provided the proper precautions were taken to insure good work. * * * The pointing on the Brooklyn Tower has withstood the weather now for some fourteen years, and you can refer to it with confidence that it will bear out what I have said." *F. O. NORTON, Cement Co., Manufacturer, 99 Broadway, New York.*

ALSEN'S PORTLAND CEMENT.

Tensile strength in 7 days, 1 part cement, 2 parts sand, 265 lbs. per square inch. Test made by W. W. MACLAY, Dept. of Docks, New York, March 19, 1892.

Alsen's Portland Cement Works, "Central Bldg.," 143 Liberty St., N. Y.

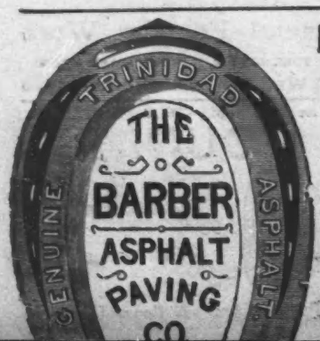
STEEL RAILS

Standard Sections,	50	to 80	lbs.	Per Yard.
Light,	16	to 45	"	"
Street Rails.	30	to 88	"	"

PENNSYLVANIA STEEL CO.,

STEPHEN W. BALDWIN, Sales Agent.

2 WALL STREET cor. Broadway, NEW YORK CITY.



TRINIDAD LAKE ASPHALT.

THE BEST QUALITY OF TRINIDAD ASPHALT,

Taken from the Celebrated ASPHALT LAKE Owned by the Government in the ISLAND OF TRINIDAD,

FOR SALE BY

THE BARBER ASPHALT PAVING COMPANY